

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF WEST VIRGINIA
AT CHARLESTON

	x	
	:	
THE CITY OF HUNTINGTON,	:	Civil Action
	:	
Plaintiff,	:	No. 3:17-cv-01362
	:	
v.	:	
	:	
AMERISOURCEBERGEN DRUG	:	
CORPORATION, et al.,	:	
	:	
Defendants.	:	

	x	
	:	
CABELL COUNTY COMMISSION,	:	Civil Action
	:	
Plaintiff,	:	No. 3:17-cv-01665
	:	
v.	:	
	:	
AMERISOURCEBERGEN DRUG	:	
CORPORATION, et al.,	:	
	:	
Defendants.	:	

BENCH TRIAL - VOLUME 36
BEFORE THE HONORABLE DAVID A. FABER, SENIOR STATUS JUDGE
UNITED STATES DISTRICT COURT
IN CHARLESTON, WEST VIRGINIA

JULY 8, 2021

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1 PROCEEDINGS had before The Honorable David A. Faber,
2 Senior Status Judge, United States District Court, Southern
3 District of West Virginia, in Charleston, West Virginia, on
4 July 8, 2021, at 9:00 a.m., as follows:

5 THE COURT: Good morning, everybody.

6 Dr. Hughes, are you in the courtroom?

7 THE WITNESS: I am, sir.

8 THE COURT: You may resume the stand.

9 **JAMES W. HUGHES, DEFENDANTS' WITNESS, RESUMED THE**
10 **WITNESS STAND**

11 THE COURT: Good morning, sir.

12 THE WITNESS: Good morning, Your Honor.

13 THE COURT: All right, Mr. Majestro, you may
14 proceed.

15 MR. MAJESTRO: Thank you, Your Honor.

16 CROSS EXAMINATION

17 BY MR. MAJESTRO:

18 **Q.** Dr. Hughes, when did payers start paying attention
19 to the number of opioid prescriptions written in West
20 Virginia?

21 **A.** It seems it was -- really got serious about 2016, 2017.

22 **Q.** And that was because they were seeing a large increase
23 in those prescriptions; correct?

24 **A.** Yes, I believe that's correct.

25 **Q.** And those -- that number of pills was a red flag that

1 caused them to rethink their coverage; correct?

2 **A.** That certainly would be part of it, but also I think in
3 that time period there was the CDC guidelines that were
4 introduced that had a big effect on payers' behavior.

5 **Q.** Okay. Let's go back and, and talk a little bit about
6 your experience.

7 You've been a testifying expert witness for the
8 pharmaceutical industry for 20 years; is that correct?

9 **A.** 20, 25 years.

10 **Q.** Okay. And, in addition, you've done consulting work
11 for 10, 15 pharmaceutical companies outside of litigation;
12 correct?

13 **A.** Excuse me. Could you say that again?

14 **Q.** You've done additional consulting work for, for the
15 pharmaceutical industry; correct?

16 **A.** Outside of expert witness work?

17 **Q.** Yes.

18 **A.** No, sir.

19 **Q.** Okay. How many cases have you served as an expert
20 witness?

21 **A.** In total, it's between 30 and 40.

22 **Q.** And it's true that all but two of those you served as
23 an expert for the defense; correct?

24 **A.** Yes, that sounds correct.

25 **Q.** And you've never published any peer-reviewed studies

1 about the pharmaceutical industry, prescription drug
2 markets, distributors, or opioids; correct?

3 **A.** That's correct. None of the work I do as an expert is
4 publishable because of confidentiality.

5 **Q.** And your work in this area has been only as a paid
6 expert, then, correct, for industry?

7 **A.** I'm sorry?

8 **Q.** Your work in this area has been only as a paid expert
9 for industry; correct?

10 **A.** Yes, that's correct.

11 **Q.** So the report and testimony that -- the report you
12 issued in this case and the testimony you've given doesn't
13 address any of the plaintiffs' experts; correct?

14 **A.** That's correct. I did not review any of the plaintiff
15 expert reports.

16 **Q.** You've never been to Cabell County or Huntington, West
17 Virginia; correct?

18 **A.** I grew up in Pittsburgh and we were in West Virginia a
19 lot. Probably. But if I was, I don't remember.

20 **Q.** Okay. Since childhood?

21 **A.** Since childhood is fair to say, yes.

22 **Q.** So the, the time period where the opioid epidemic has,
23 has blossomed, you've not been to Huntington or Cabell
24 County?

25 **A.** That's correct, sir.

1 Q. And you're not familiar with the breakdown of payers
2 for prescription drugs in Cabell or Huntington; correct?

3 A. That's correct. We looked very hard for that type of
4 information and we were not able to find it broken down by
5 county in West Virginia.

6 Q. Okay. So in this case, as you made pretty clear
7 yesterday, your, your focus is on the payers. Is it fair to
8 say you're basically saying that payers have tools to reduce
9 the use of opioids?

10 A. Yes, they do.

11 Q. And, essentially, now payers are reducing the supply of
12 opioids through the control of payment; correct?

13 A. They have definitely tightened up their controls,
14 that's true.

15 Q. And that reduction in opioid supply to these patients
16 doesn't require pain to be untreated, does it?

17 A. I'm sorry, I couldn't hear you. Could you repeat that
18 please?

19 Q. Sure. The reduction in supply caused by the payers
20 doesn't require the patients' pain to be untreated; correct?

21 A. That's my understanding, yes.

22 Q. And that reduction in opioid use by the payer entities
23 are -- those entities are outside the doctor/patient
24 relationship; correct?

25 A. Well, yeah, from an economic standpoint, they're what's

1 referred to as a third-party payer. So they are not privy
2 to the, to the discussions between the doctor and the
3 patient.

4 **Q.** In your report, you don't offer any opinions regarding
5 whether distributors have tools that also could affect the,
6 the doctor/patient decision to prescribe opioids; correct?

7 **A.** That's true. My, my report was confined to payers.

8 **Q.** Now, in this case -- and you've never done any work for
9 a distributor prior to the opioid litigation; correct?

10 **A.** No, sir. That is -- I'm sorry. It's been 25 years, so
11 I kind of have to go through the list. I'm sorry.

12 **Q.** And, so, so, in the past 25 years -- so you said -- I'm
13 sorry. I'm not sure I understood your answer.

14 **A.** I said "no."

15 **Q.** Okay. In preparing your report, you didn't speak with
16 any of the employees of the distributor defendants in this
17 case; correct?

18 **A.** I did not.

19 **Q.** You don't cite any of the distributors' documents in
20 your report; correct?

21 **A.** That's correct.

22 **Q.** You didn't review any data produced by distributors;
23 correct?

24 **A.** Excuse me?

25 **Q.** You didn't review -- sorry. You didn't review any data

1 produced by the distributors in this case; correct?

2 **A.** Because I'm not hearing "did" or "didn't," but I did
3 not review any data from distributors.

4 **Q.** Maybe I'll get a little closer to the mic and see if
5 that helps. And you're not offering opinions on what
6 distributors could have done or should have done to prevent
7 prescriptions from being filled; correct?

8 **A.** That's correct.

9 **Q.** And you're not aware of what tools distributors could
10 have had access to; correct?

11 **A.** That is also correct, yes.

12 **Q.** You have no opinion whether they had -- do you know
13 what IMS data is? IMS data?

14 **A.** Yes, sir. But I believe now it's called IQVIA.

15 **Q.** It is.

16 **A.** Okay.

17 **Q.** So you know what that is?

18 **A.** Yes, I do.

19 **Q.** You don't have any opinions as to whether the
20 distributors had access to that; correct?

21 **A.** I wasn't asked to do anything like that.

22 **Q.** Did you look at whether the distributors had access to
23 switch data or claims data?

24 **A.** No, sir, I did not.

25 **Q.** Or dispensing data?

1 **A.** No, sir.

2 **Q.** Now, distributors did have access to their own
3 transactional data; correct?

4 **A.** That's correct.

5 **Q.** And that data would have showed 81 million opiate pills
6 into Cabell County and Huntington; correct?

7 MR. HESTER: Your Honor, objection. The scope of
8 the witness's testimony on direct was confined to payers.
9 It did not get into the conduct of distributors and we were
10 quite clear that he was not offering opinions related to
11 distributors. So I object as beyond the scope.

12 THE COURT: Where are you going with this, Mr.
13 Majestro?

14 MR. MAJESTRO: Well, I guess I wonder what
15 relevance this witness has and we'll get to that later. But
16 this is the last question I have on, on that part.

17 THE COURT: Okay, overruled. I'll let you ask him
18 the question.

19 BY MR. MAJESTRO:

20 **Q.** So the distributors did have access to
21 transactional data that would have shown 81 million
22 pills shipped into Cabell County and Huntington;
23 correct?

24 **A.** I don't know what their data would have shown. I did
25 not review any of their data.

1 Q. But they would have had access to their own data;
2 correct?

3 A. Whatever that is, yes, they would have access to their
4 data.

5 Q. Okay, fair enough. You understand that opioids are
6 controlled substances distributed as part of a closed system
7 where all participants, including the distributors in this
8 case, have to be licensed by the DEA and the State Board of
9 Pharmacy?

10 MR. HESTER: Again, Your Honor, I object as beyond
11 the scope. We did not get into these issues of the DEA
12 regulations or anything related to these questions of
13 authority that counsel is raising.

14 THE COURT: Well, this is cross-examination and
15 I'm supposed to give -- allow wide latitude here. So I'll
16 overrule the objection.

17 You can go ahead, Mr. Majestro.

18 MR. MAJESTRO: Thank you.

19 BY MR. MAJESTRO:

20 Q. Do you need me to repeat the question?

21 A. Yes, please.

22 Q. You understand that opioids are controlled substances
23 distributed as part of a closed system where all
24 participants, including the distributors in this case, have
25 to be licensed by the DEA and the State Board of Pharmacy;

1 correct?

2 **A.** I know that opioids are a controlled substance. The
3 rest of it is not something I have at the tip of my tongue.

4 **Q.** Fair enough. You're aware that distributors have --
5 that there are regulations requiring the distributors to
6 take care that controlled substances aren't diverted?

7 **A.** Again, I didn't look into anything having to do with
8 distributors. So that could be correct, but I don't have
9 any knowledge of that myself.

10 **Q.** And you're -- so, then, you're not offering any
11 opinions as to whether distributors met those duties because
12 you don't know what the duties were; correct?

13 **A.** That's correct.

14 **Q.** Let's talk about payers. Payers are not part of the
15 closed system for distribution of opioids; correct?

16 **A.** Again, I'm not privy to what -- who's involved in the
17 closed system, so I don't know that one way or the other.

18 **Q.** So in any of your work, did you come across any
19 testimony or documents or reports or laws that required
20 payers to be licensed by the DEA?

21 **A.** I did not see anything like that, no.

22 **Q.** Or the State Board of Pharmacy?

23 **A.** Correct. I didn't see anything like that.

24 **Q.** And do you -- can you testify regarding whether payers
25 have any duties to actively monitor for diversion of

1 controlled substances?

2 **A.** I don't know one way or the other.

3 **Q.** But you're not offering any opinions that payers failed
4 to comply with any applicable laws; correct?

5 **A.** No, sir. That would be a legal conclusion.

6 **Q.** And you're not aware of any conduct that might show
7 that payers might have transgressed any applicable laws in
8 their coverage of opioids?

9 **A.** Yeah. That was beyond the scope of what I was asked to
10 do and it would be a legal conclusion I believe.

11 **Q.** In your report and testimony, you don't assign any
12 fault for the opioid epidemic to payers; correct?

13 **A.** I believe in my deposition I referred to it as a
14 contributing factor, but fault, no. Fault as a legal
15 concept certainly, no.

16 **Q.** Okay. And, so, you have no knowledge of whether payers
17 had any duty, so you can't say they were at fault?

18 **A.** Correct.

19 **Q.** And nowhere in your report or your testimony do you
20 opine that payers' access to data absolves distributors of
21 potential fault related to the opioid epidemic?

22 **A.** Yeah, that's beyond the scope of my assignment I
23 believe.

24 **Q.** So you're an economist; correct?

25 **A.** That's correct.

1 **Q.** Economists commonly perform quantitative analysis;
2 correct?

3 **A.** Theoretical and quantitative analysis, yes.

4 **Q.** Can you explain to the Court what quantitative analysis
5 is?

6 **A.** Basically, quantitative analysis is generally
7 considered to be the analyses of data using statistical
8 tools.

9 **Q.** And in this case, you did not perform any quantitative
10 analysis; correct?

11 **A.** That's correct. And as I said yesterday, I didn't
12 think it was necessary given all of the other evidence that
13 was available to me.

14 **Q.** You didn't attempt to quantify how many fewer pills, if
15 any, would have been shipped to Cabell and Huntington if
16 payers had acted differently; correct?

17 **A.** That's correct. I performed no such analysis.

18 **Q.** You didn't calculate or measure the extent to which
19 payers could have theoretically lessened the epidemic by
20 using tools to control opioid prescribing; correct?

21 **A.** No, I did not have the data and was not asked to do
22 that.

23 **Q.** And you're not aware of anyone else that has done that
24 analysis for Cabell and Huntington; correct?

25 **A.** I'm not aware of anyone else, that's correct.

1 **Q.** You're not opining that payers' systems were designed
2 to detect diversion or abuse of controlled substances;
3 correct?

4 **A.** No, I -- sorry. No.

5 **Q.** And, in fact, payer systems are primarily motivated by
6 decreasing cost, not preventing addiction and diversion;
7 correct?

8 **A.** Well, I think it's a little more complicated than that.
9 Certainly, the tools that I talked about yesterday, prior
10 authorization and step therapy and quantity limits,
11 certainly had their genesis back in the '80s in terms of
12 controlling.

13 But, certainly, in the post-2010 and post-2016-2017
14 period, these tools have been used, I believe, for clinical
15 reasons to reduce opioid dispensing for clinical reasons as
16 opposed to only cost control.

17 **Q.** So in essence, though, without quantitative analysis,
18 you would be speculating as to what would have happened in
19 the alternative universe where payers adopted these controls
20 earlier?

21 **A.** Oh, I don't believe so. I believe the, the academic
22 literature and testimony of, of the Medicaid representatives
23 is very clear that prior authorization and step therapy and
24 these tools are effective and, by extension, would have been
25 effective at any time they were imposed.

1 Q. Those tools were being used -- initiated while other
2 regulatory and legal and standard of care changes were
3 happening at the same time; correct?

4 A. Yes.

5 Q. So you can't, you can't identify those changes on any
6 causative basis because you have not done quantitative
7 analysis on those changes?

8 A. Well, to the extent that the changes in these rules,
9 the changes in these tools were in response to changes in
10 the standard of care, for example, the CDC guidelines, along
11 with other reports and other research that the, that the
12 payers did, I think from a statistical standpoint it would
13 be very difficult to disentangle because the change in the
14 tools happened because of the change in the standard of
15 care.

16 So I think statistically it wouldn't be possible to
17 separate out how much of it was the tool and how much of it
18 was the change in the standard of care.

19 Q. Fair enough. And you can't do that sitting here today
20 on the stand?

21 A. No, sir.

22 Q. Payers cannot directly impact cash customers; correct?

23 A. Directly, no, but academic research shows that
24 indirectly it can affect cash customers.

25 Q. And four and a quarter percent of West Virginia

1 prescriptions are cash? Did I remember that correctly from
2 yesterday?

3 **A.** Yes, sir, I believe so.

4 **Q.** What percent of opioid prescriptions are cash?

5 **A.** We did not have access to data for that. Given -- as I
6 said yesterday, given Medicaid expansion, I would expect it
7 to be about the same. But I don't have -- I did not -- I
8 was not able to find any data to that question.

9 **Q.** And you don't have any data on what percentage of
10 diverted opioid prescriptions were paid for by cash, do you?

11 **A.** That's correct.

12 **Q.** Were you aware that the DEA considers cash payments a
13 red flag for diversion?

14 **A.** No, sir. That was outside the scope of my assignment.

15 **Q.** And were you aware that where you have high diversion,
16 you have a high percentage of cash payments?

17 **A.** Again, that was outside the scope of my assignment.

18 **Q.** You have no knowledge of like pill mill pharmacies or
19 pill mill doctors?

20 **A.** That was not anything that I looked at, no, sir.

21 **Q.** In this case we've heard evidence of a pharmacy,
22 SafeScript, with more than 80 percent of prescription
23 opioids paid for in cash. Payer actions would have had
24 limited impact on this pharmacy; correct?

25 **MR. HESTER:** Your Honor, I object to lack of

1 foundation and also well beyond the scope of the direct.

2 THE COURT: Well, overruled. I'll let him answer.

3 BY MR. MAJESTRO:

4 Q. You can answer, Doctor.

5 A. I'm sorry?

6 Q. The Judge said you can answer.

7 A. Oh, I'm sorry, sir. I didn't hear you. Could you
8 repeat it, please?

9 Q. Sure. Payer actions -- well, let me follow up. We've
10 heard evidence of a pharmacy, SafeScript Pharmacy in
11 Huntington, with more than 80 percent of prescription
12 opioids paid for in cash. Payer actions would have had
13 limited impact on this pharmacy; correct?

14 MR. NICHOLAS: Your Honor, I will object. I don't
15 believe that was the testimony. There's no foundation for
16 that and that's inaccurate. So I object on that basis.

17 THE COURT: Well, I'm going to allow it. This
18 relates to the actions of payers and I think it is within
19 the scope and --

20 MR. MAJESTRO: And Mr. Farrell corrected me that
21 it's 86 percent of control versus non-control. That was the
22 testimony. I stand corrected.

23 BY MR. MAJESTRO:

24 Q. So the question is that payer actions at a pharmacy
25 that is being -- where the customers are substantially

1 predominantly paying in cash would have limited impact;
2 correct?

3 **A.** I think that's an open question given that presumably
4 those cash prescriptions were prescriptions that were being
5 written by physicians. And as the standard of care evolved,
6 presumably that would affect the physician writing the
7 prescription.

8 **Q.** And that assumption is that those were legitimate
9 prescriptions that were being written for medical,
10 appropriate medical use; correct?

11 **A.** I -- I'm sorry. Could you say that again?

12 **Q.** I said you're assuming that the prescriptions taken to
13 a pharmacy where 86 percent are paying in cash were written
14 for a legitimate medical purpose?

15 **A.** The prescriptions were written by a physician. The
16 purpose I can't speak to.

17 **Q.** Yeah. And, and a physician motivated by -- not
18 motivated by a legitimate medical purpose whose customers
19 pay in cash, payer actions would have little impact on them;
20 correct?

21 **A.** Yes, I believe that's correct.

22 **Q.** In this case, you saw no evidence that distributors
23 ever warned the payers that there was a problem in Cabell
24 and Huntington with too many opioid pills; correct?

25 **A.** That was kind of beyond the scope of what I was asked

1 to do.

2 **Q.** You didn't see any evidence in looking at, through the
3 materials you were provided; correct?

4 **A.** Well, correct, but that would have been distributor
5 materials and I didn't see any of those.

6 **Q.** Payers can share data that doesn't reveal patient HIPAA
7 protected personal information; correct?

8 **A.** It's complicated but, yes, they can.

9 **Q.** And you saw no evidence that these defendant
10 distributors ever inquired of payers why 81 million opioid
11 pills were distributed by these defendants in Cabell County
12 and Huntington, a city with -- an area with a population of
13 90,000 people?

14 **A.** No, sir. That was beyond the scope of my assignment.

15 **Q.** Thank you, Dr. Hughes. That's all I have.

16 THE COURT: Any other cross?

17 MS. KEARSE: No, Your Honor.

18 THE COURT: Any redirect?

19 MR. HESTER: No questions, Your Honor.

20 THE COURT: All right. May Dr. Hughes be excused?

21 (No Response)

22 THE COURT: Dr. Hughes, thank you, sir, very much.
23 You're free to go.

24 THE WITNESS: Thank you, Your Honor.

25 THE COURT: I would have made them finish you

1 yesterday if I had known it was going to be short. So I
2 apologize for the inconvenience.

3 THE WITNESS: Nothing could be done. Thank you.

4 MR. MAJESTRO: I will say that the evening allowed
5 me to improve my outline substantially.

6 THE COURT: Okay. All right.

7 MR. MAHADY: Good morning, Your Honor.

8 THE COURT: Good morning, Mr. Mahady.

9 MR. MAHADY: AmerisourceBergen is going to call
10 Theodore Martens, retired partner from PwC, as its next
11 witness.

12 THE COURT: Okay.

13 MR. MAHADY: He can come in and take the stand.

14 THE CLERK: Could you please state your full name?

15 THE WITNESS: Theodore Martens, M-a-r-t-e-n-s.

16 THE CLERK: Thank you. Please raise your right
17 hand.

18 **THEODORE MARTENS, DEFENDANTS' WITNESS, SWORN**

19 THE CLERK: Thank you. Please take a seat.

20 DIRECT EXAMINATION

21 BY MR. MAHADY:

22 **Q.** Mr. Martens, good morning.

23 **A.** Good morning.

24 **Q.** Mr. Martens, can you please introduce yourself to the
25 Court?

1 **A.** I'm Ted Martens. I'm a retired PwC. I reside in
2 Demarest, D-e-m-a-r-e-s-t, New Jersey.

3 **Q.** Mr. Martens, we're going to come back to your
4 professional background in a second, but I want to start
5 with your educational history.

6 Can you please describe your educational background to
7 the Court.

8 **A.** Bachelor of Science in biology, Fairfield University,
9 and an MBA in accounting, Fairleigh Dickinson University.

10 **Q.** Now, while you were obtaining your MBA, were you also
11 working?

12 **A.** I was, yes.

13 **Q.** And where were you working at the time?

14 **A.** At one of the predecessor firms to PwC, Coopers &
15 Lybrand. I joined the audit staff there in 1978.

16 **Q.** Okay. Mr. Martens, are you a certified public
17 accountant?

18 **A.** I am, yes.

19 **Q.** And how long have you been a certified public
20 accountant?

21 **A.** Since 1981, licensed in the State of New York.

22 **Q.** Okay. At any point in time did you hold temporary
23 licenses anywhere else?

24 **A.** I did, yes.

25 **Q.** And where was that?

1 **A.** In the states of Texas and West Virginia.

2 **Q.** Okay. I want to go back to your time at Coopers &
3 Lybrand. Can you please explain to the Court what your role
4 was on the audit staff?

5 **A.** As a member of the audit staff, basically being
6 assigned to audits of publicly held companies, their
7 financial statements, and within each staff classification
8 doing different accounts, auditing different accounts and
9 ultimately was admitted to the firm as an audit partner in
10 1987.

11 **Q.** Okay. And as a member of the audit staff and a CPA at
12 the time, did you regularly work with the internal records
13 of large companies?

14 **A.** Yes.

15 **Q.** And would that include their sales data?

16 **A.** Yes.

17 **Q.** Okay. Now, at some point did you become a partner?

18 **A.** I did in 1987.

19 **Q.** Okay. And did you remain in the audit staff after
20 that?

21 **A.** Yes. I was assigned to various accounts and was the
22 signing partner in terms of releasing financial statements
23 and signing on behalf of the firm.

24 **Q.** Okay. And at any point, did your role change?

25 **A.** It did. In 1990 I was asked to start a forensic

1 accounting practice in the New York office of the firm.

2 **Q.** Okay. And can you explain for the Court what forensic
3 accounting is?

4 **A.** Forensic accounting is a specialized area of accounting
5 typically -- engagements are -- we were involved in
6 engagements where there's disputes involved and typically
7 retained by counsel to focus in on specific issues at hand,
8 drilling down on those matters and so forth, and then being
9 prepared to analyze the information and provide and assist
10 counsel and the courts at times and so forth under the
11 circumstances.

12 **Q.** Okay. And, again, as a forensic accountant, did you
13 work with large datasets?

14 **A.** Yes.

15 **Q.** And did you analyze large datasets?

16 **A.** Yes.

17 **Q.** Would you consider yourself a forensic accountant?

18 **A.** Yes.

19 **Q.** Would you consider yourself an expert in forensic
20 accounting?

21 **A.** Yes.

22 **Q.** Would you consider yourself an expert in data
23 analytics?

24 **A.** Yes.

25 **Q.** Okay. At some point did Coopers & Lybrand merge with

1 another company?

2 **A.** Yes. In 1998 Coopers & Lybrand merged with Price
3 Waterhouse to form PricewaterhouseCoopers.

4 **Q.** Okay. And, so, you then became a partner at
5 PricewaterhouseCoopers?

6 **A.** That's correct.

7 **Q.** Okay. And at some point did you retire from
8 PricewaterhouseCoopers?

9 **A.** Yes.

10 **Q.** When was that?

11 **A.** That would have been in 2012. The firm has a mandatory
12 retirement age of age 60. I was extended as an active
13 partner for a year and then retired in 2012.

14 **Q.** Okay. So for the period from 2012 to 2019, in many
15 respects you considered -- you continued to work for PwC in
16 a partner-type capacity. Is that fair?

17 **A.** Correct. I was extended beyond 2012 for up through
18 July of 2019 in a client, a client consultancy capacity in
19 large part given the significant matters that I was involved
20 in for a period of time.

21 **Q.** Okay. And we're going to come back to those matters in
22 a couple minutes. But in your consultancy capacity, did you
23 continue to work with teams at PwC?

24 **A.** Correct.

25 **Q.** And did those teams help you in analyzing data for the

1 engagements you were involved in?

2 **A.** That's correct. Nothing really, nothing really changed
3 in terms of transitioning from an active partner to
4 functioning in a client consultancy capacity.

5 **Q.** Okay. And as both an active partner at PwC for many
6 years in the client consultancy capacity, did you serve as
7 an expert?

8 **A.** Yes.

9 **Q.** Okay. And did you serve as an expert in matters
10 involving state and federal litigation?

11 **A.** That's correct, yes.

12 **Q.** Approximately how many times have you served as an
13 expert?

14 **A.** Well, if you include the times I've given deposition
15 testimony and along with trial testimony and arbitration
16 testimony, I would say approximately anywhere from 125 to
17 150 times. That's an estimate.

18 **Q.** Are you aware of a court, state/federal, ever
19 precluding you from testifying?

20 **A.** No.

21 **Q.** Okay. Can you give this Court some examples of matters
22 where you've testified as an expert?

23 **A.** I was retained by the State Department in matters or
24 claims brought before the Iran U.S. Claims Tribunal. And I
25 was the lead valuation expert on behalf of the State

1 Department in what were I'll best describe as non-military
2 asset valuations and testified before the members of the
3 tribunal, a tribunal comprised of nine judges sitting in The
4 Hague, Netherlands, three American judges, three Iranian
5 judges, and then three judges from other countries, and
6 testifying there and providing my opinions with respect to
7 the calculation of how those assets should be valued with
8 respect to claims brought by the Islamic Republic of Iran
9 against this country.

10 Another matter that comes to mind is the Thomas Petters
11 ponzi scheme. This is one of the largest frauds in the
12 history of this country.

13 I've testified in countless occasions assisting the
14 trustee in claw back litigations pending, in large part, in
15 court in the Minneapolis, St. Paul area.

16 In addition to the claw back litigations where the
17 trustee is looking to recover funds from the net winners of
18 the scheme of the fraud, I've also testified in two
19 substantive consolidation trials.

20 The third matter that comes to mind is the Tobacco
21 Master Litigation -- the Tobacco Master Settlement. And
22 there I worked on that matter from its start, from its
23 inception right up through until -- for the better part of
24 20 years.

25 And there the -- that work has -- I've been testifying

1 with respect to matters that have been brought by
2 non-participating manufacturers, as well as rulings I made
3 over the years as the partner responsible for the firm's
4 role as the independent auditor of that settlement, and
5 those rulings being settled through arbitration per the
6 settlement agreement and testifying at those -- at the
7 arbitration proceedings.

8 **Q.** Have you ever served as an expert in matters involving
9 other large accounting firms?

10 **A.** Yes.

11 **Q.** Can you describe that for the Court, please?

12 **A.** Ernst & Young. I was the -- I was their liability
13 expert in the *Ernst & Young vs. Cendant* litigation and
14 testified in that matter. It was one of the largest -- at
15 the time, I believe the largest accounts malpractice matters
16 pending.

17 **Q.** Okay. Now, in those four matters you just discussed,
18 has that involved large amounts of data?

19 **A.** Yes, in all instances, that's correct.

20 **Q.** And have you and your team at PwC been tasked with
21 processing and analyzing the data to support your expert
22 work in those matters?

23 **A.** Yes.

24 **Q.** Okay. Have you ever -- any experience as an expert in
25 cases involving the pharmaceutical industry?

1 **A.** Yes.

2 **Q.** Can you explain that to the Court?

3 **A.** A number of years ago, I was retained by IMS Health to
4 analyze pharmaceutical data. And there, as I recall, it was
5 an intellectual property matter.

6 **Q.** Okay. And, Mr. Martens, just so we're clear, you have
7 not analyzed any IMS data in this case; correct?

8 **A.** That's correct.

9 **Q.** And you're not an expert on IMS data; correct?

10 **A.** That's correct.

11 **Q.** Okay. Now, in addition to serving in an expert
12 capacity, have you had the opportunity to work with federal
13 and state judges?

14 **A.** Yes, I have.

15 **Q.** Can you explain that to the Court?

16 **A.** I've been a member of the faculty of the National
17 Judicial College. The National Judicial College is located
18 on the campus of the University of Nevada in Reno.

19 And there I -- as a faculty member, I was an instructor
20 at a program entitled "Financial Statements in the
21 Courtroom." It's a program that's been offered to teach the
22 judges, teach them general accepted accounting principles,
23 financial statement preparation, and then the roles of CPAs
24 in terms of the services provided; auditing those financial
25 statements, preparing reviews, compilations, other forms of

1 financial information.

2 I teach the forensic accounting section of the program.
3 I prepare the materials and get into the business evaluation
4 section of the program as well. We -- the program -- most
5 of the time the judges will attend in Reno. Also at times
6 we take the program on the road.

7 For many years the program was offered through the
8 Federal Judiciary Center for Federal District and Federal
9 Bankruptcy Court judges. We've had probably over the
10 years -- I'd say over the past 25 years or so 6,000 judges
11 attend the program.

12 **Q.** Okay. I want to take a slight detour and ask you about
13 a different part of your background. Have you had any
14 military service?

15 **A.** Yes.

16 **Q.** Okay. And can you explain that for the Court, please?

17 **A.** I'm a retired Lieutenant Colonel, New Jersey Army
18 National Guard. I was a combat engineer and officer 30
19 years.

20 **Q.** Okay. And were you working with the -- or serving with
21 the Army National Guard while you were a partner at Coopers
22 & Lybrand and PwC?

23 **A.** Yes.

24 **Q.** Okay. And can you explain to the Court any of the
25 engagements that you had with the New Jersey National Guard?

1 **A.** Well, it was -- you know, in terms of the military,
2 moving up through the chain of command as an officer in the
3 engineer battalion and then as the division engineer on
4 staff at Fort -- it was headquartered at Fort Dix, New
5 Jersey. I mean, those, those positions were -- you know,
6 let you move up through the chain of command, you know.
7 Those were my experiences there.

8 My last billet in the Guard was a newly formed -- as
9 the Commander of a newly formed civil support team, an
10 anti-terrorism unit.

11 And at the time of 9/11, I was training at the National
12 Guard Terrorism Center in San Luis Obispo, California, with
13 other members of my team. And we were ordered to report to
14 the World Trade Center that next day and so forth to assist
15 in the operations there.

16 **Q.** Did you receive any awards or commendations during your
17 time with the New Jersey National Guard?

18 **A.** The highest award I received was the Meritorious
19 Service Medal. And that was in connection with an exercise
20 that was performed at Fort Leavenworth, Kansas.

21 **Q.** Okay. Thank you, Mr. Martens. I want to come back to
22 this matter.

23 THE COURT: Did you have any active duty before
24 you went in the Guard, Mr. Martens?

25 THE WITNESS: No, Judge, other than the active

1 duty once within the Guard, basic training and advanced
2 individual training.

3 BY MR. MAHADY:

4 **Q.** Coming back to this matter, in this matter, Mr.
5 Martens, did you work with a team at PwC?

6 **A.** I did, yes.

7 **Q.** And can you generally describe the makeup of the team?

8 **A.** The team's -- not just -- not that this is unique per
9 se to this job, but all of our jobs are typically staffed in
10 the same manner. There are people like myself with core
11 accounting, core worthy background, and then typically
12 people with technology backgrounds, people that have, that
13 have grown up with, say, degrees in computer science and the
14 like and so forth.

15 And then there's other various -- to the extent we're
16 involved in different functional -- not so much functional
17 but industry kind of situations and so forth that require
18 additional specialists and we'll bring them on board as
19 well.

20 **Q.** Okay. And was there a team that you worked closely
21 with for this matter?

22 **A.** Yes. The individual that was -- I worked closely with
23 in terms of -- in charge of really and leading the
24 technology people, his name was Rohan Sen, S-e-n.

25 **Q.** And what is Mr. Sen's educational background, if you

1 know?

2 **A.** He has a Bachelor's, a Master's, and a Ph.D. in
3 computer science, computer science field at Washington
4 University of St. Louis.

5 **Q.** And at all times, did you actively oversee the work
6 performed by the individuals on the team?

7 **A.** All work on this matter was performed under my review
8 and supervision.

9 **Q.** Okay.

10 MR. MAHADY: Your Honor, at this time we tender
11 Theodore Martens as an expert in forensic accounting and
12 data analytics.

13 THE COURT: Any objection?

14 MR. FARRELL: Judge, I'd like to preserve my
15 objection until I get a better understanding of which
16 datasets this expert is an expert in. Certainly he's very
17 well qualified.

18 THE COURT: I guess I should reserve my ruling.
19 You remind me at the appropriate time, Mr. Mahady.

20 MR. MAHADY: Thank you, Your Honor. If I don't
21 remind you, I'm sure someone on my team will remind me to do
22 so.

23 THE COURT: Okay.

24 MR. MAHADY: I am going to move forward, though,
25 with asking him about some of his opinions if that's okay.

1 BY MR. MAHADY:

2 Q. Mr. Martens, what opinions are you offering here
3 today?

4 A. I was asked to, to perform certain analyses of
5 Amerisource's business in Cabell County and the City of
6 Huntington for the period of 2006 through 2014. And I'm
7 here to -- here today to share my opinions with respect to
8 the results of those analyses.

9 Q. Okay. And have you reached any opinions about the
10 results of these analyses?

11 A. I have, yes.

12 Q. And what are those opinions?

13 A. The opinions are that Amerisource is a full-line,
14 full-line distributor of opioid and non-opioid drug
15 medications in Cabell County and the City of Huntington.
16 The mix of their business is such that they -- that
17 Amerisource sells significantly more non-opioid medications
18 than opioid medications.

19 And the tracking, the tracking, the growth, if you
20 will, the change in the business seems to track both between
21 those who compare the overall business with that of the
22 changes in the opioid business as well.

23 Q. Okay. Thank you, Mr. Martens.

24 I want to now focus on the data that underlies your
25 analysis. Can you describe to the Court what data you

1 reviewed to form your opinions?

2 **A.** The data was largely Amerisource transactional data,
3 but then also too using Dr. McCann's ARCOS data as well.

4 **Q.** Okay. And can you describe the transactional data?
5 What is it?

6 **A.** The Amerisource transactional data details essentially
7 all of the shipments, the sales that Amerisource made. And,
8 once again, the focus is on Cabell County and the City of
9 Huntington.

10 And that information details the pharmacy names, their
11 customers, their addresses, their various, you know, each
12 drug that's sold as a different, as a separate line item,
13 the national drug code, the NDC numbers are there, as well
14 as then the quantity shipped, item size, item form, data of
15 that nature.

16 **Q.** Okay. Sticking with the geographic scope of your
17 opinions here today, I believe you've testified that it's
18 Cabell County and the City of Huntington; correct?

19 **A.** Correct.

20 **Q.** Okay. And you're not providing any opinions here today
21 about specific pharmacies within Cabell County or the City
22 of Huntington; correct?

23 **A.** That's correct.

24 **Q.** Okay. And I believe you also testified that your
25 analysis is confined to the period from 2006 to 2014; right?

1 **A.** That's correct.

2 **Q.** And why did you pick that time period?

3 **A.** That time period jives with the ARCOS time period, the
4 ARCOS data time period of 2006 to 2014.

5 **Q.** Okay. And do you understand that was the time period
6 that was the focus of plaintiffs' expert Craig McCann?

7 **A.** That's my understanding, yes.

8 **Q.** Okay. Did you review the trial testimony of Craig
9 McCann?

10 **A.** I did, yes.

11 **Q.** Okay. And did you recall Mr. McCann testifying --
12 Dr. McCann testifying that he determined Amerisource's
13 transactional data to be reliable?

14 **A.** I do recall that testimony, yes.

15 **Q.** And have you reached the same conclusion in your expert
16 work?

17 **A.** Yes.

18 **Q.** Okay. I want to focus a little bit more about what's
19 included in your analysis which we will get to.

20 Your analysis includes all of AmerisourceBergen's
21 customers in Cabell County and the City of Huntington;
22 correct?

23 **A.** That's correct.

24 **Q.** And, so, that would include independent pharmacies?

25 **A.** Yes.

1 Q. Retail pharmacies?

2 A. Yes.

3 Q. And hospitals as well; right?

4 A. That's correct.

5 Q. And would that include Cabell-Huntington Hospital and
6 St. Mary's?

7 A. Yes.

8 Q. And why did you include all of AmerisourceBergen's
9 customers and not just limit it to pharmacies?

10 A. To give a, I believe, more complete picture, if you
11 will, a depiction of the full scope and breadth of the
12 business of Amerisource in Cabell County and the City of
13 Huntington.

14 Q. Okay. And you understand that AmerisourceBergen --

15 THE COURT: Just a minute.

16 MR. MAHADY: Sure.

17 MR. FARRELL: Judge, based on the proffer from
18 this witness, we have no objection to his qualifications for
19 those datasets.

20 THE COURT: All right. I find Dr. -- I find Mr.
21 Martens to be an expert in the fields of forensic accounting
22 and data analytics.

23 MR. MAHADY: Thank you, Your Honor.

24 You threw me off, Paul, in a good way, but we'll get
25 back to it.

1 BY MR. MAHADY:

2 Q. All right. The data that you analyzed includes
3 products that were shipped both in solid form and liquid
4 form; correct?

5 A. That's correct.

6 Q. All right. And the data that --

7 A. This is -- by the way, this is the Amerisource data.

8 Q. Correct. And the AmerisourceBergen data that you
9 analyzed for Cabell County and the City of Huntington also
10 included medications that were both opioid medications and
11 non-opioid medications as well; correct?

12 A. That's correct.

13 Q. Okay. And can you explain again why you considered
14 both opioid medications and non-opioid medications?

15 A. Once again, basically to give the, to give the Court a
16 full and complete picture of the scope and breadth of
17 Amerisource's sales in, in Cabell County and the City of
18 Huntington.

19 Q. Okay. Mr. Martens, how did you determine looking at
20 the data whether or not an item was an opioid or some other
21 non-opioid medication?

22 A. With respect to identifying opioid medication, there we
23 utilized the NDC codes from the Amerisource data and then
24 matched and compared them with the NDC codes in the ARCOS
25 data. And when we found a match, that drug was considered

1 and treated as an opioid drug.

2 **Q.** Okay. And since it's been a little while since we've
3 talked about the ARCOS data, just so we're clear, when we're
4 talking about the ARCOS data, we are talking about opioid
5 shipments; correct?

6 **A.** That's correct.

7 **Q.** Okay.

8 **A.** This is the, the data that Dr. McCann had processed and
9 so forth. That's the data we, we compared it to.

10 **Q.** Okay. Sticking for a second with the non-opioid
11 medications, were there any types of medications that were
12 more prevalent than others in AmerisourceBergen's data for
13 non-opioid medications?

14 **A.** Well, there was -- the ones that come to mind are blood
15 pressure medications, antidepressants, diuretics, different,
16 different drugs dealing with asthma, things of that nature.

17 **Q.** Okay. And as far as how you quantify the shipments of
18 those units for both opioids and non-opioids, can you
19 explain to the Court how you did that?

20 **A.** We applied a, a consistent approach in the sense that
21 to identify dosage units for the opioids, we multiplied and
22 took the quantity shipped times the item size that was
23 detailed in the, in the data.

24 And in the case of dealing with the opioid
25 transactions, we were able to check, to check our

1 calculations there with respect to those dosage units
2 reflected in the ARCOS data and found that our, our
3 calculations were in agreement.

4 And we applied the same approach when it came to
5 dealing with the liquid, the liquid form of these drugs;
6 taking quantity shipped times the item size and arriving at
7 the dosage units with respect to the liquid form of these
8 drugs as well.

9 So there was a consistent approach, not only consistent
10 between opioids and non-opioids, but also between liquid
11 form and solid form.

12 **Q.** Was AmerisourceBergen's transactional data for Cabell
13 County and the City of Huntington voluminous?

14 **A.** Very much so, yes.

15 **Q.** Are we talking about a couple hundred transactions or
16 are we talking about tens of thousands of transactions
17 across all products?

18 **A.** Probably more on the order of magnitude of tens of
19 thousands of transactions.

20 **Q.** Okay. And have you prepared summaries reflecting the
21 substance of the data?

22 **A.** The results of the work, yes.

23 **Q.** Okay.

24 MR. MAHADY: Ms. Pierce, if you can please hand
25 the witness AM-WV-02768 and AM-WV-02769.

1 And, Mr. Serp, if you don't mind pulling up
2 AM-WV-02768.

3 BY MR. MAHADY:

4 **Q.** Mr. Martens, starting with 02768, can you please
5 describe generally for the Court what we're looking at
6 here?

7 **A.** What this, with this graph represents is for the period
8 2006 to 2014 this, this graph is all, all -- the blue line
9 is the total both in liquid form and solid form of the
10 dosage units by transaction year for all opioid and
11 non-opioid transactions in Cabell County and City of
12 Huntington.

13 **Q.** Okay. So stopping there for one second, this blue line
14 here that we see trending, this includes all products
15 shipped by AmerisourceBergen into Cabell County and the City
16 of Huntington; correct?

17 **A.** That's correct.

18 **Q.** Will you describe for the Court what the yellow line
19 is?

20 **A.** The yellow, the yellow line is a subset of that data.
21 And the yellow line reflects the transactions involving the
22 ARCOS 14 drugs.

23 **Q.** Okay. And for purposes of this analysis, does this
24 include both opioids and non-opioids in solid form and
25 liquid form?

1 **A.** It's both. It's both solid and liquid, yes.

2 **Q.** Okay. And did you make any observations when you
3 looked at this chart?

4 **A.** I think the observation that, that one can make is in
5 terms of the trends. As you start to see the overall
6 business growing for the period in those early years, you
7 see sort of -- you see a similar trend with regards to the
8 growth in the ARCOS 14 drug line as well.

9 The one thing that you find is happening here, though,
10 is that the non-opioid growth appears to be outpacing the
11 opioid growth during that time frame.

12 **Q.** Okay. And just so we're clear here, if I understand
13 you correctly, what you're saying is looking at the blue
14 line, this blue line, non-opioid growth is outpacing the
15 growth of the opioid products; is that correct?

16 **A.** That's correct.

17 **Q.** Okay. And based off of your analysis, did both the all
18 prescription drugs and the opioid distribution drugs peak in
19 or around the same time?

20 **A.** They appear to have peaked in the same time frame
21 there, that being the year 2009.

22 **Q.** Okay. So we're looking up here to the blue line and
23 down here for the yellow line?

24 **A.** That's correct.

25 **Q.** Okay. Mr. Martens, can we move to the next chart that

1 you prepared? I believe that number is 2769.

2 **A.** 2769.

3 MR. MAHADY: Mr. Serp, can you pull that up?

4 BY MR. MAHADY:

5 **Q.** Okay. And, Mr. Martens, can you generally describe
6 for the Court what this chart shows?

7 **A.** What this chart shows is, once again, this is for all
8 products, all medications for the period 2006 through 2014,
9 Cabell County and the City of Huntington, essentially the
10 business mix.

11 You have in the, in the blue bars there on the chart
12 the percentage of non-opioid transactions, and then with the
13 orange the percentage of opioid transactions for each of the
14 years.

15 **Q.** Okay. So if we just start in 2006, just so I
16 understand this correctly, to make sure I understand it
17 correctly, the entire bar reflects the totality of
18 AmerisourceBergen's distribution into Cabell County and the
19 City of Huntington for 2006; correct?

20 **A.** The entire bar, that's correct, yes.

21 **Q.** Okay. And this includes both liquid and solid form
22 drugs; correct?

23 **A.** For this, for this chart, that's correct, yes.

24 **Q.** Okay. And am I correct that 5.76 percent of
25 AmerisourceBergen's distribution for that year, 2006,

1 reflected opioid medications?

2 **A.** That's correct.

3 **Q.** And 94.24 percent reflected non-opioid medications?

4 **A.** That is correct.

5 **Q.** Okay. And I know this is somewhat annoying, but can
6 you just go through from 2006 to 2014 and just read the
7 percentage of opioids and the percentage of non-opioid
8 medication for each year just for the record?

9 MR. FARRELL: Judge, I'm sorry. If it saves any
10 time, the plaintiffs would stipulate and allow for the
11 admission of the document if he doesn't want to read it all
12 in.

13 MR. MAHADY: That does save some time. We were
14 going to move at the end for the admission of these under
15 Federal Rule of Evidence 1006. We can do that now.

16 THE COURT: Is there any objection to the
17 admission into evidence of these documents?

18 MR. FARRELL: No, Your Honor.

19 THE COURT: Okay. They are both admitted. 02769
20 and 02768 are admitted.

21 MR. MAHADY: Thank you, Your Honor.

22 BY MR. MAHADY:

23 **Q.** So, Mr. Martens, I'm not going to have you read the
24 numbers now. But did you make any observations off of
25 your analysis reflected in this chart?

1 **A.** I think what the chart reflects is, is that the sale of
2 the non-opioid medications was significantly greater than
3 the opioid medication transactions for all of the years
4 within the time period.

5 **Q.** Okay. And just circling back on one point, the two
6 charts we looked at, those included medications that were
7 shipped in liquid form; correct?

8 **A.** These, these two drugs are both liquid and solid.

9 **Q.** Okay. And that would include medications that were
10 shipped to the hospitals and pharmacies in liquid form;
11 correct?

12 **A.** That's correct.

13 **Q.** Okay. Did you also prepare two charts that just
14 focused solely on medications shipped in solid form?

15 **A.** I did, yes.

16 **Q.** Okay.

17 MR. MAHADY: Ms. Pierce, can you hand those to Mr.
18 Martens, please?

19 Mr. Serp, if you can please pull up AM-WV-02770.

20 BY MR. MAHADY:

21 **Q.** Okay. Mr. Martens, can you please describe
22 generally what this chart reflecting your analysis and
23 summary contains?

24 **A.** This chart reflects the similar analysis as to what I
25 just described with respect to the, the first two charts.

1 This chart, however, is focused solely on solids only;
2 in other words, taking from the item form of the
3 transactional data solids, pills, caplets, capsules and
4 identifying the total dosage units by year, 2006 through
5 2014 for transactions in Cabell County and the City of
6 Huntington. That's the blue line at the top, and then a
7 subset of that data in the orange line below for the ARCOS
8 14 drug data.

9 **Q.** Okay. So just so I'm clear, the blue line reflects all
10 solid form medications that AmerisourceBergen distributed
11 into Cabell County and the City of Huntington for the 2006
12 to 2014 time period; correct?

13 **A.** Solids only, correct, yes.

14 **Q.** Okay. And the orange line down here reflects the
15 opioid solid form that AmerisourceBergen shipped into Cabell
16 County and the City of Huntington for that time period as
17 well; correct?

18 **A.** That's correct.

19 **Q.** Okay. Could we please move to the next chart which is,
20 for the record, AM-WV-02771.

21 And, Mr. Martens, can you describe what this chart
22 shows?

23 **A.** This is now a bar chart reflecting the percentages of
24 non-opioid versus opioid sales transactions, solids only,
25 into -- you know, distributed to Cabell County and City of

1 Huntington for the period 2006 to 2014.

2 **Q.** Okay. So even if we were to strip out
3 AmerisourceBergen's distribution of liquid products to its
4 customers in Cabell County and City of Huntington, only
5 84.31 -- or only 15.69 percent of the pill forms were for
6 opioid products; correct?

7 **A.** That's correct, right.

8 **Q.** And 84.31 percent of the pill form products that it
9 shipped into Cabell County and the City of Huntington were
10 for something other than opioid products; correct?

11 **A.** That's correct. Those are non-opioid medications.

12 **Q.** Okay. And is that generally consistent across the time
13 period from 2006 to 2014?

14 **A.** Generally consistent. I think you'll find that
15 there's -- the distribution -- appears to be generally
16 consistent, yes. There's a few percentage points here and
17 there. But by and large, you can see that there's a, still
18 a significant amount of non-opioid medications being
19 transacted, distributed when compared to the opioid
20 transactions.

21 **Q.** Okay. Let's see if we can spare the witness and the
22 Court from reading the numbers.

23 MR. MAHADY: Your Honor, at this time we will move
24 AM-WV-02770 and AM-WV-02771 into evidence under Federal Rule
25 of Evidence 1006.

1 THE COURT: Any objections?

2 MR. FARRELL: No objection, Your Honor.

3 THE COURT: They're both admitted.

4 MR. MAHADY: Thank you, Your Honor.

5 BY MR. MAHADY:

6 Q. Mr. Martens, do you offer all of the opinions here
7 today with a reasonable degree of professional
8 certainty?

9 A. I do.

10 MR. MAHADY: At this time, I have no further
11 questions. Thank you, Mr. Martens.

12 THE COURT: Okay. You may cross-examine.

13 CROSS EXAMINATION

14 BY MR. FARRELL:

15 Q. Good morning, Doctor. My name is Paul Farrell. We
16 haven't had a chance to meet yet.

17 A. Good morning. I'm not a doctor.

18 Q. Oh, I'm sorry. You have the pedigree of one with your
19 background and experience.

20 A. Well, thank you.

21 Q. I just had a couple of questions for you.

22 You testified that you reviewed Dr. McCann's processed
23 ARCOS data as part of your analysis; correct?

24 A. That's correct.

25 Q. And you said that you also reviewed the

1 AmerisourceBergen transactional data?

2 **A.** That's correct.

3 **Q.** And just to be clear that you're aware that
4 AmerisourceBergen's transactional data is broader in time
5 than the ARCOS data?

6 **A.** I understand that there's broader data available, yes.

7 **Q.** And I believe you just testified that the
8 AmerisourceBergen data you found to be reliable. My
9 question is did you also find the McCann processed data to
10 be reliable as well?

11 **A.** I did, yes.

12 **Q.** No faults with Dr. McCann's math?

13 **A.** With respect to Dr. McCann's math on --

14 **Q.** The processed data.

15 **A.** The processed data, yes.

16 **Q.** No faults?

17 **A.** I don't know if I could go so far as to say no faults,
18 sir, but I found it to be reliable.

19 **Q.** Thank you.

20 MR. FARRELL: Can we bring up 2768 that was just
21 admitted?

22 BY MR. FARRELL:

23 **Q.** Exhibit 2768, the bottom line here is the opioids
24 sold by AmerisourceBergen into Huntington, Cabell County
25 between 2006 and 2014; correct?

1 **A.** That's correct.

2 **Q.** And this is just the -- this framing of time is just
3 because that's what the overlap is between ARCOS and
4 AmerisourceBergen's transactional data?

5 **A.** That's how, that's how the analysis was performed and
6 that's how this chart reflects the results of the analysis
7 to match with the ARCOS time frame.

8 **Q.** Now, if you were to add up all of these numbers on the
9 bottom line, it comes to -- and I won't ask you to do the
10 math -- 49 million dosage units.

11 My question, sir, is have you undertaken any analysis
12 as to whether 49 million dosage units have any economic
13 impact upon Huntington/Cabell County, West Virginia?

14 **A.** I have not performed such an analysis, no, sir.

15 **Q.** Did you make some analysis as to whether during this
16 time frame 49 million pills were appropriate for the size
17 population?

18 **A.** I have not performed such an analysis, no, sir.

19 **Q.** And did you take the orange line here that goes over
20 time and compare it to other orange lines for other counties
21 in West Virginia?

22 **A.** I have not performed that task, no, sir.

23 **Q.** Or any other county in the United States?

24 **A.** I have not performed that, no, sir.

25 **Q.** But could you have, based upon the data provided by

1 AmerisourceBergen, compared the volume of pills in
2 Huntington/Cabell County to other places around the country?

3 **A.** Well, to the extent I had the data, I could re-perform,
4 I could re-perform that analysis, yes, sir, not just, not
5 just around the country but for the State of West Virginia
6 if that's your question.

7 **Q.** Okay. And what about pricing? Were you able to
8 determine the -- how much revenue was generated from the
9 sale of these pills?

10 **A.** I did not, I did not do that calculation, no, sir.

11 **Q.** But could you have?

12 **A.** I'm not sure. I'd have to, I'd have to check to see if
13 the information is available. I would assume that these
14 transactions are driven over the sales and the sales ledgers
15 at the company and then identify what the, what was for each
16 item and so forth in the charts and so forth pulling that
17 off the transactional data.

18 **Q.** And when were you hired in this case, sir?

19 **A.** It's hard -- I started working on the State of West
20 Virginia information I want to say probably in the summer of
21 2020.

22 **Q.** Thank you. No further questions.

23 THE COURT: Any redirect, Mr. Mahady?

24 MR. MAHADY: No redirect, Your Honor. Thank you.

25 THE COURT: May the witness be excused?

1 MR. FARRELL: Yes, Your Honor.

2 THE COURT: Colonel Martens, thank you, sir, very
3 much. You're free to go.

4 THE WITNESS: Thank you, Judge.

5 MR. HESTER: Your Honor, the defense calls our
6 next witness, Dr. Kevin Murphy.

7 THE COURT: All right.

8 MR. HESTER: Is it convenient for the Court to
9 take a break now or would you prefer that we get started?
10 I'm happy to do it either way, Your Honor.

11 THE COURT: Well, let's go ahead and take 10 now.

12 (Recess taken at 10:03 a.m.)

13 THE COURT: All right. Mr. Hester?

14 MR. HESTER: Your Honor, the defense calls Dr.
15 Kevin Murphy to the stand as our next witness.

16 COURTROOM DEPUTY CLERK: Please state your name.

17 THE WITNESS: Kevin M. Murphy.

18 COURTROOM DEPUTY CLERK: Thank you. Please raise
19 your right hand.

20 **DR. KEVIN M. MURPHY, DEFENSE WITNESS, SWORN**

21 COURTROOM DEPUTY CLERK: Thank you. Please take a
22 seat.

23 THE COURT: Good morning, sir.

24 THE WITNESS: Good morning, Your Honor.

25 **DIRECT EXAMINATION**

1 **BY MR. HESTER:**

2 **Q.** Good morning, Dr. Murphy. Could you please introduce
3 yourself to the Court?

4 **A.** Yes. My name is Kevin M. Murphy. I'm a George J.
5 Stigler Distinguished Service Professor of Economics in the
6 Graduate School of Business in the Department of Economics
7 at the University of Chicago.

8 **Q.** And, Dr. Murphy, when did you complete your education?

9 **A.** I got my BA, I believe, in 1981 from UCLA, University
10 of Southern -- University of California at Los Angeles, and
11 I got my Ph.D. degree from the University of Chicago in
12 1986.

13 **Q.** And how long have you been an economics professor at
14 University of Chicago?

15 **A.** I started teaching at University of Chicago, I believe,
16 in 1983 while I -- before I finished my Ph.D. degree, I
17 started teaching at the university and I've been there since
18 then teaching. From '83 until today, I teach at the
19 university.

20 **Q.** And what departments do you teach in at the university?

21 **A.** I teach in both Booth School of Business and the
22 Department of Economics.

23 **Q.** So, Dr. Murphy, could you give the Court a sense as to
24 the reputation of the University of Chicago in the field of
25 economics?

1 **A.** It has a pretty good reputation in economics. It's
2 produced probably the most number of Nobel Prize winners, I
3 think, out there. People like Milton Friedman and George
4 Stigler, very famous economists taught there. Gary Becker
5 was one of my mentors out there.

6 THE COURT: I'm well familiar with the reputation
7 of the University of Chicago.

8 MR. HESTER: It was a little bit of a softball for
9 Dr. Murphy.

10 BY MR. HESTER:

11 **Q.** What courses do you teach at the University of Chicago?

12 **A.** I teach microeconomics, which is the study of markets
13 and how markets work. I also teach labor economics. I also
14 teach public policy. I also teach a course in sports
15 analytics. But the core of my teaching is really in the
16 microeconomics area and I'm very fortunate to be able to
17 teach in both Booth and the Department of Economics Ph.D.
18 program in that.

19 **Q.** And, Dr. Murphy, when you refer to microeconomics,
20 maybe you could expand on that a little bit more. What's
21 the focus of microeconomics?

22 **A.** In economics, we make two broad distinctions between
23 macroeconomics, which is the people who talk about GEP and
24 the growth of the economy as a whole and things like that.
25 I like to think of that as the voodoo side of economics.

1 Then we do the microeconomics, which is kind of what I
2 do, which is really the study of markets and how markets
3 work. And that's what I do in my research and that's what I
4 do in my teaching. It gives you some insights at the macro
5 level, but it's much more focused on individual markets and
6 how they operate.

7 **Q.** And so, is it fair to say that the focus of your work
8 is on the behavior of firms and the behavior of particular
9 markets?

10 **A.** Yeah. I would say to understand a market, you usually
11 have to think about both the supply and the demand side.
12 Where you think about the customers and the ultimate users
13 of a product on one side and the providers of the product on
14 the other side, including the supply chain component of
15 that. That's a part of economics we cover a lot in micro
16 called drive demand, where we study demand for various
17 components or parts of the products that are ultimately
18 sold.

19 **Q.** And beyond your role in teaching, Dr. Murphy, do you
20 publish academic research in the field of economics?

21 **A.** I do. I've published a number of papers in a pretty
22 wide area of economics.

23 **Q.** Do you have a sense roughly as to how many papers
24 you've authored or co-authored?

25 **A.** About 80, I think I've published on, either authored or

1 co-authored over my career.

2 **Q.** And have those articles been published in a number of
3 the leading scholarly and professional journals?

4 **A.** Yes, they have. I've published in Journal of Political
5 Economy, American Economic Review, Quarterly Journal of
6 Economics. Those are probably the top journals in
7 economics.

8 **Q.** And have some of the articles that you've written been
9 widely cited in the field?

10 **A.** They have. I have a number of works in different areas
11 that have been pretty widely cited.

12 **Q.** Are there a few you could just give us as
13 illustrations?

14 **A.** Yeah. I did -- I did some of the early work on growth
15 and income and equality and changes in the patterns of
16 unemployment and education. I've done work on health
17 economics and the value of improvements in health and
18 longevity that's been widely cited in the health economics
19 area.

20 I've done work on the markets for illegal drugs,
21 addiction. Those would probably be the areas that are cited
22 most. Similarly, my work on economic growth also is pretty
23 highly cited.

24 **Q.** Have you also published some books on economics?

25 **A.** I have. I've published books on social economics, on

1 price theory, which is really throughout my microeconomics
2 courses that I teach and particularly my Ph.D. class. Also,
3 edited books on healthcare and markets and value of health
4 and longevity.

5 **Q.** Dr. Murphy, have you received any awards during the
6 course of your career in economics?

7 **A.** I have. I received the John Bates Clark medal, which
8 is -- at the time was awarded every other year to the
9 outstanding American economist under 40. As you can guess,
10 that was awhile back. I'm no longer under 40.

11 I also received a MacArthur from the MacArthur
12 Foundation and I was awarded the Kenneth J. Arrow prize for
13 the outstanding paper in health economics. So, yeah, I have
14 a number of awards.

15 **Q.** Other than your work at the University of Chicago, are
16 you also affiliated with any other organizations?

17 **A.** I am. I -- I'm affiliated with Charles River
18 Associates where I am a senior consultant.

19 **Q.** Are you also a member of some academic academies?

20 **A.** Yes. I'm a member of the American Academy of Arts and
21 Sciences, a member of the Society of Labor Economists. I
22 don't remember all of the other ones.

23 **Q.** Are you also affiliated with the Econometric Society?

24 **A.** Yes. I'm a fellow of the Econometric Society. Sorry.
25 I forgot about that one.

1 **Q.** And do you also have a role with the National Bureau of
2 Economic Research?

3 **A.** I do. I'm a -- I don't remember the title, but I've
4 been with the NBER, the National Bureau of Economic
5 Research, for -- since the 80s. So, you know, almost 40
6 years now.

7 **Q.** Dr. Murphy, you mentioned you serve as a senior
8 consultant to Charles River Associates. Can you describe
9 what Charles River Associates is?

10 **A.** Yes. It's a consulting firm and, certainly, the part
11 I'm involved is an economic consulting operation where we
12 consult on a wide range of matters, including litigation
13 matters like this.

14 **Q.** And are there some particular kinds of matters that you
15 focused on in your consulting work for Charles River?

16 **A.** I've done a fair number of different things.
17 Antitrust. I do a lot of work in antitrust. I've done work
18 on patent damages. I've done work on labor cases. I've
19 done work on health -- you know, healthcare-related things.
20 I've done a number of things.

21 **Q.** So, during your time at Charles River Associates or in
22 relation to that affiliation that you have, have you worked
23 on problems related to the pharmaceutical industry?

24 **A.** I have. I've worked on a number of pharmaceutical
25 matters.

1 Q. Have you previously served as an expert witness in
2 litigation?

3 A. Yes, I have.

4 Q. And how many times roughly have you served as an expert
5 witness?

6 A. You know, it's hard to know. I can't remember.
7 Testifying in trial, probably between 10 and 20 would be the
8 number of times I've testified at trial. I've given more
9 deposition testimonies than that, clearly, because a lot of
10 things don't go to trial.

11 Q. And have a number of your expert engagements involved
12 matters related to health economics or the pharmaceutical
13 industry?

14 A. They have.

15 Q. Have you previously been qualified as an expert in the
16 field of economics?

17 A. Yes, I have.

18 Q. Have you previously submitted expert testimony to the
19 United States Congress?

20 A. Yes, I have.

21 Q. Could you describe that briefly?

22 A. Yeah. I just -- I have testified before the U. S.
23 Senate on minimum wages, would be the one that I remember.

24 Q. And have you previously submitted expert testimony, as
25 well, to state regulatory bodies?

1 **A.** I have.

2 **Q.** Could you describe that just briefly?

3 **A.** Yeah. I've submitted testimony in Illinois, before
4 state regulatory bodies in Illinois.

5 **Q.** In the course of your expert engagements, are you
6 always representing private companies or have you also
7 worked for other kinds of entities?

8 **A.** I've worked for the federal government. I've consulted
9 for both Department of Justice and the Federal Trade
10 Commission.

11 MR. HESTER: Your Honor, at this time, we would
12 tender Dr. Murphy as an expert in the field of economics
13 with a specialty in health economics.

14 THE COURT: Any objection?

15 MR. FARRELL: Again, reserving the right,
16 depending on the subject matter that he's being proffered
17 for here, but he's certainly an expert in both those general
18 fields.

19 THE COURT: Well, I find him to obviously be an
20 expert in the fields of economics and especially health
21 economics.

22 BY MR. HESTER:

23 **Q.** So, Dr. Murphy, in your career as a professional
24 economist, have you developed an expertise in market forces
25 and supply chain? I think that's probably a pretty easy one

1 for you.

2 **A.** Yeah. I think I answered that already. And, yes,
3 that's part of -- a big part of what we do in
4 microeconomics.

5 **Q.** And does any of that expertise relate specifically to
6 economics of healthcare markets?

7 **A.** It does. I've done work on healthcare markets, you
8 know, related to both innovation, as well as payment
9 structures, things like that, about how those -- the forces
10 that work in healthcare markets.

11 **Q.** And in connection with your work on this matter, have
12 you reviewed materials related to the Closed System of
13 Distribution for controlled substances like prescription
14 opioids?

15 **A.** I have. Again, I am not an expert from the point of
16 view of all the legal aspects and the regulatory aspects. I
17 am an economist. So, my understanding is the economics of
18 that industry and how that industry works from an economics
19 perspective.

20 **Q.** And based on your experience and your review of these
21 materials, have you been able to develop an understanding as
22 to the role from an economics perspective that distributors
23 play in that system of distribution of controlled
24 substances?

25 **A.** I have.

1 **Q.** And what's the -- what's the understanding you've been
2 able to develop?

3 **A.** Well, I think the way to think about it is
4 distributors' role is that they -- they purchase
5 pharmaceuticals from manufacturers and distribute them and
6 sell them to the pharmacies or other distribution outlets
7 downstream and, therefore, the amount that they distribute
8 is -- for example, of a controlled substance like opioids
9 would be determined by the prescribing behavior because it's
10 the prescribing behavior that determines the amount that
11 pharmacies are going to need to fill those prescriptions and
12 that then in turn determines how many prescription opioids
13 are going to be shipped.

14 **Q.** So now, there's been testimony in this case about an
15 alleged oversupply of prescription opioids in Cabell County
16 and the City of Huntington. Have you had a chance to review
17 some of that testimony?

18 **A.** I have. And let me kind of tell you how an economist
19 would think about that. In economics we make a distinction
20 between three things that are related but different.

21 One is what we might call quantity, or consumption, or
22 level of output, depending on whether you're looking at it
23 from the consumer's point of view, or the producer's point
24 of view, or just the market point of view. That's the
25 outcome. That's how many units were sold in the

1 marketplace.

2 We think of a separate thing called supply, which is on
3 the -- forces that work on the supplier side of the market
4 and demand and the quantity you see is a function of both
5 the supply and demand.

6 It's not a measure of supply per se. It's a measure of
7 the quantity which is a function of both. So you want to
8 keep that in your mind when you talk about like the level of
9 output or the level of consumption. It really is an
10 outcome.

11 And, for example, you can't say, well, geez, we had
12 more output and, therefore, there was an increase in supply.
13 Economists wouldn't think about it that way.

14 You know, people consume more gasoline. It could be
15 because we discover a lot of oil and oil prices go down and
16 people buy more gasoline because it's cheaper, but it also
17 could be a bunch of people move to the suburbs and they get
18 richer and they demand more gasoline and the quantity of
19 gasoline goes up for demand forces. And just the fact that
20 the quantity went up doesn't tell you it was something going
21 on on the supply side.

22 **Q.** And so, in relation in particular to the distribution
23 of prescription opioids and the sale of prescription
24 opioids, is there a particular driver of demand that you've
25 identified?

1 **A.** Yeah. As I said a bit ago, I think prescriptions -- if
2 you wanted to think about market like this and what's going
3 to determine the quantity, it's going to be the prescribing
4 behavior.

5 **Q.** And why is that?

6 **A.** Well, because in order to sell a prescription,
7 legitimate prescription, or a legal prescription in this
8 marketplace, you have to have a prescription.

9 This is not like you go down to the grocery store and
10 say, you know, oh, I see there's a stack of doughnuts. I'll
11 buy some doughnuts. That's not how this works.

12 You need a prescription to buy it and my understanding
13 of the evidence in this case is that the opioids that were
14 distributed were distributed overwhelmingly for -- through
15 prescriptions. So, it's prescriptions would be the driver.

16 **Q.** And you had mentioned before, Dr. Murphy, that the
17 responsibility for prescriptions lies where?

18 **A.** Well, if you think about who influences the
19 prescriptions primarily, at the point of the spear, kind of
20 like where that actually happens, it's going to be the
21 doctors and the patients, right?

22 Ultimately, the doctor is going to decide to write a
23 prescription and the patient plays a role in that and, you
24 know, then there's a question of whether patient fills that
25 or not. That's also a patient level. So, it's doctor and

1 patient that probably play the greatest roles. All the
2 other things that might influence doctors and patients but,
3 ultimately, it's going to work through them.

4 **Q.** So, given these factors that you're discussing in this
5 industry, do distributors determine the quantity of
6 prescription opioids that are sold in a community?

7 **A.** Well, they -- not directly because they don't really --
8 they don't really have levers at the level of prescription,
9 that if you think about a distributor's decision, they're
10 not deciding about whether to supply opioids for a
11 particular prescription and they're not deciding whether
12 those opioids dispensed through that prescription are going
13 to be used by legitimate use or diverted in some other way
14 once they're outside the pharmacy, right? They don't --
15 they don't act at that level. They act at a more aggregate
16 level where they're making decisions on -- you know, on --
17 their distributing the product to the pharmacy, but not
18 affecting the prescriptions directly.

19 **Q.** And when a pharmacy places orders with a distributor,
20 what's your understanding as to what the pharmacy is doing?
21 How does the pharmacy decide on how much it chooses to order
22 from a distributor?

23 **A.** Again, I'm going to give you economics, right? The
24 pharmacies are a profit maximizing business. They're out
25 there looking for their -- to run their business. They're

1 going to distribute opioids, it's my understanding, pursuant
2 to prescriptions.

3 So, when they order, they're going to order based on
4 what they expect to get in terms of prescription volume. It
5 doesn't -- it's not in their interest to have opioids just
6 piling up in the pharmacy if there's not prescriptions to be
7 filled. So, they're going to base their orders on some
8 anticipated notion of prescriptions. That's what economics
9 tells us.

10 **Q.** So, is an association between the quantity of opioids
11 sold in a community and the -- and opioid mortality
12 significant or meaningful from an economic perspective?

13 **A.** Well, I think it depends on the question you're asking.
14 If you're asking does that tell me something about, say,
15 distributor behavior, probably not. Not very helpful in
16 that regard.

17 The idea that when there are more opioids being
18 consumed there might be more things like overdoses, that
19 kind of in an extreme sense has to be true, right, because
20 if you didn't consume any opioids, you couldn't overdose on
21 prescription opioids.

22 So, it doesn't really tell you about why. It doesn't
23 tell you what happened. It just tells you kind of the
24 outcome, not -- not the genesis of that outcome.

25 **Q.** So, there's an association between the quantity of

1 opioids sold in the community and opioid mortality
2 established that distributors' conduct caused that increased
3 mortality?

4 MR. FARRELL: Judge, before we move forward, I
5 just wanted to make sure that the testimony that was being
6 elicited is from an economic standpoint and an economic
7 analysis only. That question was broad enough that it
8 invokes other disciplines perhaps, such as epidemiology, but
9 to the extent that the question is parked or framed in terms
10 of economics, we have no objection.

11 THE COURT: Well, I'll overrule it. Well, you
12 don't have an objection.

13 You can answer the question, Dr. Murphy, if you
14 remember what it was.

15 THE WITNESS: Can I get it repeated?

16 BY MR. HESTER:

17 Q. Sure, sure, sure.

18 A. That would help me. Sorry about that.

19 Q. Dr. Murphy, does an association between quantity of
20 opioids sold in the community and opioid mortality establish
21 that distributors' conduct caused that increased mortality?

22 A. No. I mean, again, if you study the economics, there's
23 -- you know, that would -- that association would exist even
24 if distributors did nothing to cause that.

25 Q. So, maybe just talk a little bit more broadly from the

1 perspective of economics, Dr. Murphy, about the relationship
2 between these terms association and causation. Talk a
3 little bit about that.

4 **A.** Well, they're different because association, it's
5 really more of a statistical concept but, you know, part of
6 economics is we do a lot of statistical work and, certainly,
7 that's a big part of my career, is applying economics to
8 data.

9 Association just tells you things move together.
10 There's a tendency for A to go up when B goes up.

11 So, for example, you would see an association between
12 rain and the use of umbrellas, right? There's a pretty
13 strong association. People tend to use umbrellas when it's
14 raining, but you wouldn't infer that umbrellas cause it to
15 rain.

16 You know, I might have a drought. I can't run outside
17 with my umbrella and put it up and get rain to come down.
18 You know, that would be a misinterpretation and that would
19 be an example of distinction between -- in that case, it's
20 sort of simple because causality runs the other way.

21 Sometimes, things are associated where there's no
22 causality either way. They just are both caused by the same
23 forces. So, there's a big difference between association
24 and causation.

25 **Q.** So, when we use this phrase association, does it

1 signify that two things are observed happening together or
2 sequentially? Is that what it means?

3 **A.** Association could be different types of association.
4 There's what we would call a time series association, which
5 means over time they happen together. There could be a
6 cross-sectional association, the same locations where A
7 happens, B also happens; or when A doesn't happen, B doesn't
8 happen, right? Those would be both notions of association,
9 one over the time dimension and one over the cross-sectional
10 dimension.

11 **Q.** So, Dr. Murphy, have you analyzed the relationship
12 between the shipments of prescription opioids and
13 opioid-related mortality?

14 **A.** I have.

15 **Q.** And have you prepared a demonstrative as part of your
16 expert report in this matter that would assist in explaining
17 your analysis?

18 **A.** Yes, I have.

19 MR. HESTER: So, let's see if we can put that up
20 on the board.

21 BY MR. HESTER:

22 **Q.** So, Dr. Murphy, we've put up on the board here an
23 exhibit from your expert report. Can you describe what's
24 depicted on this chart?

25 **A.** Yeah. This has got two lines on it, so this is what we

1 call a line chart. The years are on the horizontal axis and
2 what we're measuring is on the vertical axis. So, those
3 lines tell you at each year point for that year what was the
4 level of the indicated variable.

5 So, the left hand axis is MMEs per adults in West
6 Virginia. That's the blue line. And it shows you how it
7 behaves.

8 So, basically, MME per adult was going up from the
9 beginning of the dataset here and peaks right around
10 2011-2012, after which it has a pretty precipitous decline.

11 So, actually, if you look at this outcome we call
12 quantity or shipments it's right at the outcome. It's not a
13 measure of supply. It's just a measure of outcome. That
14 was what shipments did over this period of time.

15 So, they first rose and then declined in the last, you
16 know, seven years, six years or seven years of the data.

17 **Q.** And let me just pause you there again just to make sure
18 we've got it clear between this point you made about supply
19 and quantity. The blue line, which shows a rise between
20 1995-96 and 2010-11 and then a decline going out to 2017,
21 that's reflecting a quantity in the marketplace; is that
22 fair to say?

23 **A.** Yes. I mean, you could think about it as it's
24 quantities of shipments. It's the number of opioids
25 shipped. It's quantity measure. It's a measure of the

1 outcome in the market, which is a function of both supply
2 and demand.

3 **Q.** And as a matter of economics you would view that
4 quantity as the outcome of decision making by doctors?

5 **A.** I think if you -- yeah. Ultimately, in this case, it
6 would be determined by the decision making of doctors and
7 patients, right, because doctors work to get -- you know,
8 the prescription is something that's done between the doctor
9 and the patient because, hopefully, doctors take some input
10 from the patients and my understanding is that they do. So,
11 it would be the both of them and that's not to say that
12 there are other things that come in.

13 For example, I saw somebody earlier today talked about
14 payers. Payers have some influence on those prescriptions
15 because they determine the terms under which, for example,
16 reimbursement is going to happen, which is going to
17 influence prescribing behavior. So, they're kind of inside
18 that -- that -- that decision making process.

19 **Q.** So, let's look at the underline here, the black line.
20 Could you describe what that is, Dr. Murphy?

21 **A.** That's mortality rate measured as deaths per 100,000
22 people. So, it's the opioid mortality rate, including both
23 licit and illicit opioids. I think people talked about that
24 already, so I'm not introducing anything new there, but it's
25 all types of opioid mortality over that time period.

1 And what you see here is it's not a really simple
2 association, right? We're not talking causation at this
3 point. We're talking about just simple association. The
4 association here isn't one where one goes up the other one
5 always goes up. We had two very distinct periods. They
6 were both going up. So, that's called -- up through 2010 or
7 so, maybe it's '11, you know, right around in that time
8 period.

9 And then they -- you know, if anything, mortality
10 accelerates and shipments go down. So, you have to kind of
11 understand. You know, if you want to understand what's
12 going on, you really want to understand both those periods.
13 How do I -- how do I think about the marketplace from an
14 economics standpoint what's going on in those two periods.

15 **Q.** So, just to be clear, the opioid mortality line here
16 includes both illicit and prescription opioids, correct?

17 **A.** It does. That's what I said. The mortality -- all
18 opioid mortality -- the shipment data are only -- obviously,
19 because they'll come from ARCOS, they're going to be
20 prescription opioids.

21 **Q.** And could you expand a little bit on your point that
22 it's not a simple association?

23 **A.** Yeah. We talked earlier about association, right? We
24 talked about it as one thing goes up, the other one goes up
25 or one goes up and the other goes down. Those would be

1 called positive and negative associations.

2 The associations here look really different in these
3 two time periods. We had this first period where they were
4 both going up; and then, we had the second period where one
5 -- the shipments are going down but, if anything, the
6 mortality is going up faster, not slower.

7 **Q.** And so, what does that tell you about the need to
8 evaluate this association? Where do you go from here as
9 you're evaluating this?

10 **A.** Well, I think you need to try to understand those two
11 periods. You need to understand what was going on in that
12 earlier period. And then, you particularly need to
13 understand that later period and you need to understand
14 well, geez, why is mortality going up in this later period
15 while prescription opioid shipments are actually going down?
16 So, it's getting behind these figures, I think, that's
17 important.

18 **Q.** So, let's talk first about that pre-2010 period, Dr.
19 Murphy. During that pre-2010 period, again, what do you see
20 happening with prescription opioid shipments and opioid
21 mortality?

22 **A.** They're both going up and, again, that's telling me
23 that people -- there were more pills being consumed or
24 presumably. It would certainly be more shipped and more
25 prescriptions being written. So, we had more and more

1 prescriptions for opioids over this period and over that
2 period mortality was going up.

3 It doesn't tell us a causal story in a sense of was it
4 supply, was it demand. There probably is some link between
5 quantity of one and the other because, as I said earlier,
6 you can't overdose if you don't take it in the first place.

7 But that doesn't establish, for example, something like
8 a causal relationship back to distributors, again, because
9 it's coming through prescriptions, presumably, it's working
10 through prescriptions. And, as I said earlier, distributors
11 aren't really the primary or even significant determinant of
12 those prescriptions being written.

13 **Q.** So then, let's look at the post-2010 period. At that
14 time, after 2010, what's happening between prescription
15 opioid shipments and opioid mortality?

16 **A.** Well, we'll get behind that in a minute, but what's
17 happening at the gross level, obviously, as I said earlier,
18 is that prescription -- shipments of prescription opioids
19 are going down, but mortality is going up and, indeed, going
20 up more rapidly, if anything, than it was before.

21 **Q.** And so, what was driving the increase in opioid
22 mortality in this period after 2010?

23 **A.** It was an expansion, if you -- well, we'll see this in
24 a moment. It's an expansion in the use of heroin and, in
25 particular, the growth of fentanyl as a much more lethal

1 form of illicit opioid.

2 **Q.** And have you had occasion to analyze this point about
3 the relative impact of illegal opioids like fentanyl and
4 heroin on opioid mortalities? Is that something that you've
5 looked at for the process?

6 **A.** I have.

7 **Q.** And what are the results you've reached at the highest
8 level? We'll drill into it in more detail, but what are the
9 -- what's the highest level conclusion you've reached?

10 **A.** I would say it was what I said just a moment ago, that
11 it's really the growth and mortality in that later period
12 that's really driven by a growth in, first, heroin
13 mortality; and then, later, a substantial growth in
14 fentanyl-related mortality.

15 **Q.** So, let's go on to the next exhibit where we can drill
16 into this a little bit more. So, we've put up Exhibit 33,
17 Dr. Murphy. Is this another exhibit from your report?

18 **A.** It is. It was Exhibit number 33 in my report. That's
19 where the 33 came from because it's not 33 for today. We're
20 sparing you a lot of the other ones.

21 **Q.** What does this chart reflect?

22 **A.** It looks at adult deaths per 100,000. So, that's a
23 mortality rate. And it breaks it out between prescription
24 opioids, which is the black line, and heroin and fentanyl
25 together, which is the blue line.

1 So, I'm not separating heroin and fentanyl right now.
2 I'm putting those together. So, we'll call those the
3 illicit opioids, heroin and fentanyl, although some of the
4 fentanyl is actually prescription. So, it's not quite all
5 illicit even though, in the later period, most of it is
6 going to be illicit, but --

7 **Q.** So, just for the record, could you describe the shape
8 of the -- of the black line, the prescription opioid line?

9 **A.** Yeah. The prescription opioid line is rising up
10 through that same 2011 or so period, after which it
11 declines.

12 Now, I should say one thing. Sometimes and it's not --
13 you know, we have people when they die who have both heroin
14 or fentanyl and prescription opioids. In this figure, I've
15 put that mixed group into the heroin and fentanyl category.
16 That's the more lethal category.

17 **Q.** Why did you do that?

18 **A.** It seemed -- if you were going to put them one place or
19 the other, it seemed like a better place because those are
20 the more lethal drugs. So, it seemed to make more sense to
21 put them there.

22 I've also re-done this chart done the other way. It'll
23 make the heroin and fentanyl line go up a little less
24 because you're taking people out of that one and the decline
25 in the prescription one is a little -- is less. So, it

1 won't change qualitatively the story. I just wanted to make
2 sure that was clear how I had done it.

3 **Q.** So, this is showing opioid mortality rates. So -- so,
4 what does it show about the prescription opioid mortality
5 rates?

6 **A.** Well, it says that they were going up until about 2011.
7 And then, since 2011, they've been going down.

8 **Q.** And what does it show about the illicit drug mortality
9 rate, heroin and illicit fentanyl?

10 **A.** Well, be careful. Remember, heroin is illicit, but
11 fentanyl, there's some of both, right? And chemically you
12 can't tell whether it was prescription fentanyl or -- or
13 illicit fentanyl. So, they're combined together in this
14 blue line, but that huge increase in that later period, I
15 will give you -- show you how you know that in the later
16 period is mostly the illicit fentanyl driving that.

17 **Q.** Yeah. I was going to ask you that. Your understanding
18 is most of the spike period here we're seeing after 2011 or
19 so reflects illicit fentanyl?

20 **A.** Yeah. I think that's generally accepted. I think Dr.
21 Keyes, you know, found the same thing. I don't -- I don't
22 know of anybody who would disagree with that as the big
23 story for that later period.

24 **Q.** So now, let's go to the next exhibit. Dr. Murphy,
25 we've put up another chart on adult opioid mortality rates.

1 What does this chart show?

2 **A.** Again, this is -- now this is taking that -- remember
3 in that previous graph, 33, I had heroin and fentanyl
4 together? Here, I'm breaking them out separately. And so,
5 I've got the green line being the heroin and fentanyl being
6 the blue line.

7 Now, again, we're going to have this overlap issue.
8 So, I've put in the fentanyl category anything that has
9 fentanyl. So, if it's fentanyl and heroin, it goes in the
10 blue line. If it's only heroin, it goes in the green line.

11 **Q.** And just for the record, could you describe what the
12 heroin line -- what the shape of the heroin line is?

13 **A.** Yeah. The heroin really begins increasing pretty
14 significantly. It had been creeping up earlier, but it
15 really begins increasing around 2010. It peaks in 2015,
16 after which it declines somewhat. Fentanyl is pretty flat
17 between 2010 and 2013, but then skyrockets starting around
18 2013.

19 THE COURT: Mr. Farrell?

20 MR. FARRELL: I would simply ask for a geographic
21 scope to be proffered for the record, Your Honor.

22 BY MR. HESTER:

23 **Q.** What is the geographic scope of this chart, Dr. Murphy?

24 **A.** Thank you very much for clarifying. This is the U. S.
25 as a whole. So, this is the U. S. chart. This is opioid

1 mortality for the U. S. as a whole and what we just talked
2 about, all those timing issues, pertain specifically to the
3 U. S. as a whole.

4 **Q.** That's a nice segue to the next question I had on my
5 outline. Do these patterns also hold true in West Virginia,
6 Dr. Murphy?

7 **A.** Yeah. I mean, at a general level, you see a similar
8 timing story for West Virginia. All of the magnitudes are
9 different. Now, that's an important thing to keep in mind.

10 **Q.** So, let's go to Exhibit 35.

11 **A.** Right.

12 **Q.** So, Dr. Murphy, what do these charts show?

13 **A.** Well, these charts do -- remember, we had just looked
14 at 33 and 34, which were the U. S. as a whole. 33 was
15 prescription in the black line and heroin and fentanyl in
16 the blue line. We've just re-done that here in the same
17 methodology for West Virginia.

18 And, again, what you see is that the prescription
19 mortality is rising up until about 2011 and declines after
20 2011 and the heroin and fentanyl mortality again starts
21 going up. Again, it was rising, but it starts rising much
22 more rapidly after, you know, 2012 or so.

23 **Q.** And then, what does Exhibit 36 show?

24 **A.** Exhibit 36 shows kind of a similar pattern to what we
25 saw before, which is, you know, heroin first rising after

1 2010, rising up peaking, in this case, around 2013 and then
2 going down and fentanyl really taking off after 2013.

3 Two things to note here. Again, I've done the
4 divisions of the overlaps the same way I did before. So,
5 the overlap story is the same.

6 But also, the scales here. That scale, I think, on the
7 other chart went to 14. The scale here goes to 50. So,
8 even though they look similar in terms of shapes, it's a
9 much bigger magnitude in West Virginia. So, what happened
10 in the U. S. happened to a greater extent in West Virginia.

11 **Q.** And when you say a greater extent, what do you mean by
12 that, Dr. Murphy?

13 **A.** Just the magnitude. Just, you know, so we're at a peak
14 here. At a heroin and fentanyl death rate above 40, we're
15 going to peak for the U. S. as a whole at a much smaller
16 number than that.

17 **Q.** So, as we look at these West Virginia charts, what does
18 this tell you about the present day opioid mortality in West
19 Virginia?

20 **A.** It's overwhelmingly driven by heroin and fentanyl and,
21 in particular, fentanyl. Fentanyl is where the action is in
22 terms of mortality today.

23 **Q.** And when you're referring to fentanyl, are you
24 referring to illicit fentanyl?

25 **A.** It's -- and we'll see some evidence more from this

1 later. You know, not all fentanyl is going to illicit.
2 There is -- there is prescription fentanyl, but the big
3 increase is from illicit fentanyl.

4 **Q.** Dr. Murphy, have you performed an analysis as to
5 whether increased prescription opioid shipments prior to
6 2010 drove the increase in illicit opioid mortality after
7 2010? Is that a question you've looked at?

8 **A.** I have. I've done some economic analyses to try to get
9 at that question.

10 **Q.** And maybe we could just pause again for a second.
11 What's the reason to look back at shipments before 2010 of
12 prescription opioids to evaluate the impact on opioid
13 mortality after 2010? What's the reason to do that?

14 **A.** Well, there are two reasons. One is, obviously, the
15 story in the late-year period is illicit mortality,
16 particularly in mortality associated with fentanyl. The
17 greatest level of shipments were occurring in that earlier
18 period and, in my understanding of what I've read in Dr.
19 Keyes and others of the plaintiffs' theories, is that really
20 what we see in that later period was driven by the
21 prescribing behavior that happened in the earlier period.
22 And so, it was the earlier prescription opioid, you know,
23 decisions or the outcomes that drove the later period. And
24 I tried to evaluate that from an economic standpoint.

25 **Q.** And what is the opinion you've reached at a high level?

1 **A.** I would say the theory -- the economic evidence doesn't
2 really fit that theory very well. I think that the evidence
3 that I've seen really seems to say, you know, there's a lot
4 of things going on after 2010-11 that really aren't that
5 well associated or, you know, don't fit with the story that
6 it was the result of the conduct pre-2011.

7 **Q.** So -- so, in other words, what is the link you see
8 between shipments of prescription opioids before 2010 and
9 the increases you observe in illicit opioid mortality after
10 2010?

11 **A.** Well, I'm going to evaluate that for purposes of my
12 analysis on three dimensions. I'm going to look first
13 across states. And I'm going to ask was this states where
14 we saw more shipments in that earlier period the same states
15 where we saw more morality at the later period, right? That
16 is, under the theory that it was the shipment levels that
17 were driving, remember, we're not talking about causality
18 back to distributor. That's even yet further removed.

19 We're just here looking at did higher shipments
20 associated with more mortality later? Higher shipments
21 before 2010, are they associated with higher mortality
22 later?

23 A second one is if you look at who is dying, you know,
24 look at like by ages and gender, who is it that's dying in
25 that post-period? Are those the same groups of people who

1 were taking prescription opioids or abusing prescription
2 opioids in that earlier period? That is, is there somehow
3 to link these two things up either by looking across states
4 or linking them by looking across people? You don't really
5 see that.

6 And, finally, I'm going to look at this rise in a later
7 period and show that, in fact, it's very different in
8 different parts of the country even though different parts
9 of the country have very similar prescribing behavior early.
10 And that also says there's something else going on here and
11 it has to do with the illicit supply of opioids in this
12 world.

13 **Q.** So, let's drill into each of those in more detail, but
14 I first wanted to clarify a point you made just now in your
15 answer, which was you said this is even separate and apart
16 from whether distributors caused the increase in shipments.
17 And could you just explain that again just to make it clear
18 what your analysis is?

19 **A.** Yeah, because everything I'm doing right now is just to
20 say is it the same places where there were lots of shipments
21 that have -- in the early period have more mortality in a
22 later period? Is it the same groups who had lots of
23 prescriptions in the early period and who had more mortality
24 in the later period? And are there differences across
25 regions of the country in those outcomes even though they

1 were very similar in terms of shipment?

2 So, nothing in there is ascribing why those shipments
3 were what they were in the early period. Given what they
4 were, does that seem to drive the later period?

5 **Q.** And so, all of this analysis is based on your earlier
6 discussion about the reasons that shipments increased based
7 on prescribing behavior?

8 **A.** Yeah. It would be -- it really is about the outcome.
9 The outcome was driven by prescribing behavior and did that
10 higher prescribing behavior somehow predict what we see
11 later, either cross-sectionally, group-wise, and understand
12 the differences across regions.

13 **Q.** So, let's drill into more detail on these three points
14 you've made. First, I believe you said that the data do not
15 show a strong relationship between shipments of prescription
16 opioids in 2000 and increased mortality from heroin or
17 fentanyl later?

18 **A.** Right. So, I'm going to divide the world. If we're
19 looking at shipments, I'm going to look pre-2010 and I'm
20 going to measure for each state how much -- how much on a
21 per capita basis there was in terms of shipments. Remember,
22 this is just an outcome.

23 And then, I'm going to measure mortality in the later
24 period and say is there a relationship there? Do the places
25 have more quantity in the early period the same places that

1 had more mortality in the later period?

2 **Q.** So, let's put up Exhibit 49 from your report. So, Dr.
3 Murphy, maybe we can just take one of these plots and have
4 you explain what it signifies.

5 **A.** Yeah. Each state is going to be a dot on this plot,
6 right? So, for each state, we know what the MME shipments
7 were per adult per year, 1997 to 2010. That determines
8 where you are on the horizontal axis.

9 And then, we look at your mortality rate and, in the
10 left-hand panel, we're looking at heroin mortality. In the
11 right-hand panel, we're looking at fentanyl mortality. And
12 we're asking is there a relationship here? Do we see a
13 relationship between where you are on the horizontal axis
14 and where you are on the vertical axis, which if you thought
15 that it was consumption or quantity in the earlier period
16 that was really an explanatory factor for mortality in a
17 later period, you would expect to see an association here.

18 And what you really see is a very weak association. In
19 the left-hand panel, the unweighted correlation is .16. The
20 population correlation is .006, essentially 0, but both of
21 those numbers are quite small.

22 **Q.** So, let's just go back --

23 **A.** And you can kind of see it in the picture. There's not
24 a clear pattern in this picture. It tells you one is
25 strongly associated with the other and, indeed, a

1 correlation of .16 is -- for this sample size is not
2 statistically significant; that is, it's not something
3 greater than what you'd expect to see by chance, which is
4 the statistical notions of significance.

5 **Q.** So, you're referring to these correlation coefficients
6 that are stated up here?

7 **A.** Yeah. The .16 on the left and .13 on the right. One
8 way to think about it is .16 is the correlation. You have
9 to actually square that number, which becomes like .02 --
10 you know -- 256. So, it tells you that about a little --
11 about two and a half percent of the variation in mortality
12 is explained by shipments. Essentially none. That means 97
13 and a half percent and, on the right-hand panel, .13 squared
14 is 1.6. 0169, which is less than two percent. It says
15 essentially all the variations not explained by -- by
16 shipments in the earlier period.

17 **Q.** So, in other words, the variation, the variation in
18 death rates, is not explained by the variation in shipment
19 rates in the earlier period?

20 **A.** Not to any significant extent.

21 **Q.** And so, what is that telling you? What conclusion do
22 you draw from this?

23 **A.** Well, a story -- again, this doesn't get back to
24 whether it was, you know, distributor behavior, but even
25 beyond that, just saying what is it -- there's a story that

1 says what's driving mortality in the later period, the level
2 of shipments in the earlier period as an outcome, we just
3 don't see it. It's just not there in the cross-section
4 here.

5 **Q.** So, the conclusion you draw is that you can't see a
6 relationship between these death rates in the later period
7 and the shipment rates in the earlier period?

8 **A.** I would say it's not just you can't see. You can
9 measure and that's what the correlation does here. And the
10 correlation says there's really not a relationship. And the
11 overwhelming amount of the variations do something else, not
12 the shipments.

13 **Q.** So, let's -- let's turn to the next analysis you did.
14 I believe you mentioned that you see age differences between
15 the population that was prescribed opioids prior to 2010 and
16 those who were overdosing from the legal over -- of opioids
17 after 2010. Is that a fair characterization?

18 **A.** Yeah. I think it gets at this question, again, of
19 whether there's a link; that is, is it the people who are
20 getting more prescriptions in the early period who then
21 moved over to illicit opioids and were dying from illicit
22 opioids in the later period?

23 And if that -- you know, a simple version of that story
24 would be you should see the same groups, right? The groups
25 that were getting lots of prescriptions, consuming lots of

1 opioids, would be the same groups that would show up later.

2 **Q.** So, let's take a look at Exhibit 44 from your report.
3 What conclusions do you draw on that issue?

4 **A.** Yeah. If you look at prescriptions in the earlier
5 period, again, that's 2001 to 2010, the biggest groups
6 getting the prescriptions were, number one, older women.
7 That's 51 years of age and older. They accounted for
8 31.6 percent of prescriptions. Older men, 51 and older,
9 counted for 25.3 percent of prescriptions.

10 And young men and young women accounted for very few
11 prescriptions, only 3 percent for males and another 3
12 percent for women. So, young people together were like 6
13 percent; whereas, older men and women were, what is that,
14 57 percent. So, you know, almost ten times as much
15 prescriptions among the older people as the younger people.

16 **Q.** And then, what do you see in terms of the mortality
17 rates in the later period?

18 **A.** Well, you see kind of the reverse, that the biggest
19 mortality rates are for the young in this case, where the
20 younger individuals and the middle-age individuals who are
21 the bulk of mortality and the older people account for --
22 particularly older women, remember, who are the biggest
23 people getting the prescriptions in the earlier period are
24 very much underrepresented in the mortality data.

25 **Q.** So, what's the significance of that? What does it tell

1 you when you observe that the group that was receiving the
2 most -- the highest percentage of prescriptions in the
3 earlier period isn't reflected in the later mortality
4 levels? What's the significance?

5 MR. FARRELL: Again, as we change to each slide,
6 all I'd ask is, for the record, the geographic scope be
7 defined.

8 BY MR. HESTER:

9 Q. What are you discussing here, Dr. Murphy?

10 A. This is nationwide data for -- we can do mortality
11 state by state, but because of the data we have on the
12 prescriptions, we can't do state by state. So, we were --
13 we had to do this one at the national level.

14 Q. And do these mortality figures that you're analyzing at
15 the U. S. level, do you see them as having relevance in West
16 Virginia?

17 A. Yeah. Because the age patterns you can see, you know,
18 they're not exactly the same, but qualitatively they're
19 going to be very similar. And you would see something
20 similar to this, I believe, if you looked at what -- we know
21 on the mortality side we would see something similar to this
22 and I don't have reason to believe the prescription side
23 would be different.

24 Q. So, what conclusion do you draw when you see a heavy
25 weighting of older people and the prescriptions between 2001

1 and 2010 and a heavier weighting of mortality in a younger
2 group after 2010? What conclusion do you draw?

3 **A.** It sort of says a story that says it's the people who
4 were getting the prescriptions back then who then shifted
5 over to getting -- to consuming illicit opioids. It doesn't
6 fit the data very well, particularly when you look at the
7 younger group, because a lot of that younger group, you
8 know, the bottom half of that 15 to 30 group were children
9 in the earlier periods. So, they're going to be -- you
10 know, they weren't there at all. So, you know, it does say
11 that that simple story doesn't really fit the data very
12 well.

13 **Q.** And when you say the simple story, what are you
14 referring to there?

15 **A.** I'm saying the simple story of individuals transiting
16 from -- that what you're seeing in the later period is just
17 the same group of people who used to be getting
18 prescriptions now abusing nonprescription opioids.

19 **Q.** Have you also looked at these -- this same point about
20 age differences in terms of overdose levels?

21 **A.** I have because, you know, one of the things of looking
22 at prescriptions is you could say, well, geez, those are
23 getting the prescriptions, but how do I know who is actually
24 abusing them? And, you know, that age distribution can be
25 different.

1 And so, what I did is, I used mortality for both now.
2 I'm going to use mortality, who's dying in the earlier
3 period, and comparing that to who -- the distribution of who
4 is dying in the later period. So, it's getting closer to
5 looking at abuse rather than prescriptions.

6 **Q.** So, let's look at Exhibit 47. So, Dr. Murphy, what
7 does this chart show? It's age distribution at the time of
8 death by opioid type. What does that tell you?

9 **A.** Okay. This is a little complicated. I mean, I think
10 people are probably familiar with the usual kind of bell
11 curve story. It's just telling you how a population is
12 distributed across ages.

13 So, for example, the black line in this figure, I'll
14 say this is for the U. S. So, this is for the U. S. as a
15 whole.

16 The black line in this figure is telling us that the
17 modal level of age is in the -- around age 50, right; that
18 is, the peak of that black line is about age 50.

19 **Q.** And when you say the black line, you're referring to
20 the prescription opioid line during that period, 1999 to
21 2010?

22 **A.** Correct. In that earlier period, we're looking now not
23 at who is getting a prescription, but whose overdose deaths,
24 and we're saying the biggest numbers in that period are
25 50-year-olds, around 50. And, you know, kind of the highest

1 levels are running, say, in this graph between 40 and 60,
2 whatever you want to say. That's the peak of the black
3 line.

4 **Q.** And then, when we look at this, at both the green and
5 the blue lines, those are showing us heroin and fentanyl
6 overdoses, 2010 to 2018; is that right?

7 **A.** Right. So, you know, roughly ten years later. Kind of
8 think of it that way. We're looking at what age groups are
9 the predominant among the illicit deaths and you can see
10 that's predominantly to the left.

11 **Q.** So, when it's an age group that has an average roughly
12 around what?

13 **A.** Well, an average -- you can't -- the mode is about 30,
14 right? The biggest -- what we call the mode, that's where
15 the highest point of this curve is around 30.

16 But you can see that there's a skewed much more left
17 toward younger ages for the later mortality; whereas, the
18 earlier period mortality was skewed much more right. And,
19 remember, these are ten years apart and people are getting
20 older.

21 So, if it was the same folks the curve would be moving
22 to the right, not to the left, right? Because, remember,
23 this is -- the green and blue lines, we're ten years later.
24 So, somebody who is at 40 on the black line would be ten
25 years to the right on the green or blue line.

1 **Q.** So, what conclusion do you draw from this chart?

2 **A.** It's kind of -- it says it sort of similar to what we
3 saw with the prescriptions. There's a difference in the
4 groups, a pretty substantial difference in who is overdosing
5 on illicit opioids in a later period, and who was overdosing
6 on prescription opioids in the earlier period.

7 **Q.** So, what does that tell you about this point of
8 transition from prescription opioids to illegal -- illegal
9 opioids?

10 **A.** It says it's -- again, it gets -- it pushes against a
11 view that this is really the same population of individuals
12 moving from one to the other.

13 **Q.** You also had mentioned geographic differences in opioid
14 and, in particular, fentanyl mortality, I believe; is that
15 right?

16 **A.** Yes.

17 **Q.** And could you explain that in more detail?

18 **A.** Yeah. It turns out that the story of what happened
19 with opioid mortality, in particular, heroin and fentanyl
20 mortality is pretty different in the eastern U. S. and the
21 western U. S.

22 **Q.** Let's put up a chart from your report on that. What
23 does this chart reflect?

24 **A.** Okay. The chart reflects -- again, it's kind of like
25 the first chart we put up today where we had shipments on

1 the blue line and we have mortality on the black line. We
2 have the same concepts we used in the first chart we put up.

3 **Q.** So, just for the record, could you describe what you
4 show here in terms of states east of the Mississippi and
5 west of the Mississippi?

6 **A.** Yes. So the left-hand panel is states west of the
7 Mississippi. If we're measuring shipments per -- per MME
8 per adult year by year in the blue line on the left. On the
9 right we're measuring exactly the same thing, but for the
10 east to the Mississippi River, that's the -- that's the blue
11 line on the right.

12 And you can see they're not exactly the same, but
13 follows the same general pattern. Both the east and the
14 west, the shipment data rise until we get to about 2010 or
15 '11 and then decline. They're a little higher east than
16 they were west but, you know, the general pattern is very,
17 very similar.

18 Actually, interestingly, if you look at mortality
19 pre-2010, it's also very similar, that by the time you get
20 to 2010, they're both right around 7 or 8 in terms of
21 mortality.

22 But then, after 2010, they just behave completely
23 different. In the west, the mortality rises only very
24 slightly. In the east, mortality goes way up, goes from,
25 you know, 7 or 8 up to the 20s. So, very different stories

1 east and west and mortality, even though they're very
2 similar stories on shipments and, indeed, even though they
3 were very similar stories on mortality prior to 2010.

4 **Q.** And so, what conclusion do you draw from this?

5 **A.** Well, something else is going on in this period and
6 it's differing a lot between the east and the west and, as
7 it turns out, the most logical one and the one that seems to
8 be supported by the data is it has to do with the nature of
9 the heroin supply in the two parts of the country, that the
10 western U. S. has traditionally been supplied with black tar
11 heroin, which is much harder to cut with fentanyl, and the
12 eastern U. S. is much more powder heroin for which fentanyl
13 is much easier to use.

14 **Q.** And so, when you said, Dr. Murphy, something else is
15 going on, something else aside from what? What are you --

16 **A.** What I'm saying is it's not the shipment story per se
17 as it is the nature of the illicit drug market and changes
18 in the illicit drug market, and particularly the expansion
19 of fentanyl and the availability of fentanyl, which is much
20 greater in the east than in the west, accounts for the much
21 greater increase in mortality in that greater period.

22 **Q.** And so, let's look at Exhibit 42. So, again, here's
23 another take on this geographic variation point. Could you
24 describe what this reflects, Dr. Murphy?

25 **A.** Again, remember when we broke out the opioid mortality

1 rates between prescription opioids and heroin and fentanyl.

2 I did that in my second chart that I had.

3 This does it separately, exact same calculation, but
4 separately for east and west. And what you see is the
5 prescription opioid mortality looks like -- kind of behaves
6 the same way east and west. It goes up until about 2010 or
7 '11 and then goes down both east and west.

8 But you see the heroin and fentanyl mortality just goes
9 way, way faster in the west than it does the east and,
10 really, the biggest distinction between the two is that
11 latest period where fentanyl really plays the big role.

12 **Q.** And do you have an understanding as to why that would
13 be, why -- why the fentanyl mortality would be rising so
14 much faster in the east?

15 **A.** Yeah. It's back to what I said before. It's really
16 the nature of the supply chain in the illicit market, right?
17 It's the illicit market supply chain that's driving that.

18 **Q.** And could you describe in a little more particularity
19 what it is about the supply chain that makes fentanyl more
20 likely to be showing up in the east than the west?

21 **A.** Yeah. I think my understanding and, again, this has
22 been -- you know, people -- this has been looked at by
23 people in literature, is that it has to do with the nature
24 of the supply chain in terms of the types of heroin that are
25 being distributed in two parts with black tar heroin for

1 Mexico being the primary supply of heroin in the west and
2 powder heroin, I believe, mostly from Colombia being a
3 supply in the east.

4 **Q.** And so, what's the -- what's the significance of powder
5 heroin versus black tar heroin for the fentanyl issue?

6 **A.** Well, the economics of fentanyl are a very cheap way
7 for drug dealers to lower -- a way for them to lower their
8 cost is to use fentanyl rather than heroin in their powder.
9 It's much harder to mix the fentanyl in, in the black tar
10 heroin, is my understanding. I'm not a drug dealer, so I
11 can't tell you by firsthand experience, but my -- that's my
12 understanding of how it works.

13 **Q.** So, let's -- let's put up the next chart, please. So,
14 Dr. Murphy, this is another chart that's compiled from data
15 out of your report. Could you explain what this one
16 reflects?

17 **A.** Yeah. This is heroin and fentanyl mortality east and
18 west of the Mississippi and you really do see that there's a
19 divergence that happens east and west in that post-2011
20 period.

21 So, I've got three lines on this chart, the national
22 line which, you know, would be the same as what we had in
23 the first chart we went through today. We have the east,
24 which is the orangish line. And the west, which is the blue
25 line. And you can just see how different they are.

1 You know, they kind of are about the same in 2010 and
2 really kind of had gone up together through 2010. And then,
3 they just spread apart dramatically afterward.

4 **Q.** And you said they spread apart. Can you just, for the
5 record, describe what happens after 2010?

6 **A.** Yeah. The heroin and fentanyl mortality in the west
7 rises from, you know, let's say 3, a little less than 3 in
8 2010. In the west, it goes up to, reading this chart here,
9 6 and a half or so. And nationally it goes up from about
10 that same level to, you know, 13 and a half. And in the
11 east it goes up to, you know, 19, over 19.

12 **Q.** So, what's the significance of these geographic
13 variations? What does that tell you, Dr. Murphy?

14 **A.** It highlights the importance of the illicit drug market
15 in driving the increase in mortality in that later period.
16 It really highlights the role that the illicit drug market
17 played.

18 **Q.** And do you see it as contradicting the simple story of
19 a transition from prescription to illegal drugs?

20 **A.** I would say it -- it's kind of -- it kind of tells you
21 that there's something else going on. It's not saying that
22 that couldn't be anything. It's just saying if you want to
23 understand this later period, you've really got to look at
24 the illicit market.

25 Now, when you combine it with the other pieces of

1 information, right, the other -- I take the first one where
2 I had the scatter chart across states. Combining all of
3 these together says, look, earlier supply doesn't seem to
4 tell the story on any of these dimensions. It doesn't tell
5 you which states. It doesn't tell you which individuals.
6 And it doesn't explain the biggest difference we see, which
7 is geographic.

8 **Q.** Now, we were discussing this point about the
9 differences in the ages between the people who had either
10 received prescriptions for opioids or had overdosed on
11 opioids during the earlier period up to 2010 and the later
12 period of looking at both overdoses and for heroin and
13 fentanyl. Does that point -- that point was based on
14 national data; is that right, Dr. Murphy?

15 **A.** That was based on national data.

16 **Q.** Now, would you -- would you view that point as applying
17 to West Virginia?

18 **A.** Like I said, I can't do the prescription one for West
19 Virginia, although I would have viewed it as applying. You
20 can do the age one for West Virginia. You would have some
21 issues because data suppression in CDC WONDER, but when you
22 do that, you see that same -- you see kind of qualitatively
23 that same distinction with a shift left in the distribution
24 in a later period to younger ages in West Virginia. It's
25 just harder to do because you have less data.

1 **Q.** So, what's the conclusion out of these three factors?
2 What's the conclusion you draw about the story of a
3 transition from prescription opioids to illegal drugs?

4 **A.** The economic evidence doesn't fit that story very well
5 at all. That, you know, like I said before, it's not in the
6 same states. It's not in the same groups. And the big
7 distinction we see east and west doesn't seem to be
8 explained by that.

9 **Q.** Let me shift gears, Dr. Murphy, and talk about Dr.
10 Keyes and her OUD methodology. Are you familiar with the
11 analysis that Dr. Keyes engaged in to estimate an OUD
12 population in Cabell County and the City of Huntington?

13 **A.** Yes, I am.

14 **Q.** And have you reviewed her testimony and work papers on
15 that issue?

16 **A.** Yes, I have.

17 **Q.** And based on that review, have you come to an
18 understanding at a general level as to how Dr. Keyes
19 purports to estimate the prevalence of OUD in
20 Cabell-Huntington?

21 **A.** Yes, I have.

22 **Q.** And can you describe for the Court at a general level
23 how Dr. Keyes estimated the prevalence of OUD in
24 Cabell-Huntington?

25 **A.** Yeah. What she attempted to do was use the number of

1 drug overdose deaths together with a mortality rate to
2 calculate an implied population at risk; in this case, an
3 implied OUD population.

4 **Q.** And would it help you to explain your point to work on
5 the board for a minute?

6 **A.** It sure would. It would put me back in a much more
7 familiar setting for me.

8 MR. HESTER: Your Honor, may Dr. Murphy approach
9 the board?

10 THE COURT: You may step down, Dr. Murphy. Put on
11 your teacher hat.

12 THE WITNESS: Yes.

13 Uh-oh. I'm used to blackboards, so this is high tech
14 for me.

15 MR. HESTER: I'm going to erase it for you first.

16 THE WITNESS: You even have an eraser? How are
17 you going to erase it? This is fancy.

18 MR. HESTER: Nice, huh?

19 THE WITNESS: We don't have these in Chicago. I
20 always use a chalkboard. All right. So --

21 BY MR. HESTER:

22 **Q.** Okay. So, Dr. Murphy, why don't you explain your
23 understanding of Dr. Keyes' methodology?

24 **A.** Yeah. I'm going to start, actually, predicate of that
25 methodology. So, if you think about just the simple kind of

1 mathematics of it, you can think of deaths for a group,
2 whatever group you're looking at, would be -- should be
3 equal to the population in that group times the mortality
4 rate in that group, right?

5 So, if I had a population of a million people and I had
6 a 1 percent death rate, I could multiply a million by .01
7 and I would say I expect 10,000 deaths. That's just -- it's
8 really arithmetic, right? It sort of says this is
9 population times the death rate should give me the number of
10 deaths. And, in fact, if you constructed your death rate
11 from this data this would hold exactly, right, because that
12 would be the definition.

13 Now, you can reverse this same equation using algebra
14 and re-write this as deaths divided by the mortality rate
15 should be equal to the population. The same equation just
16 re-written by saying, okay, I can infer the population if I
17 know deaths for that population and I know the mortality
18 rate for that population.

19 You know, now, what's important is that when you do
20 this, you have deaths corresponding to the population you
21 want and you have the mortality rate corresponding to the
22 population you want.

23 If you got the wrong number of deaths, because you look
24 at deaths for a different population, you're not going to
25 get your population back from this formula. And if you have

1 the wrong mortality rate, you're not going to get the
2 population back.

3 **Q.** And based on your review of Dr. Keyes' work and her
4 work papers, do you have an opinion as to whether she
5 reliably applied this methodology?

6 **A.** No.

7 MR. FARRELL: Judge, I'm going to place a
8 preliminary objection on foundation. Again, from an
9 economic standpoint, I don't think there's any standing to
10 argue with the University of Chicago professor, but for
11 purposes of the Economics Department of Chicago criticizing
12 the Epidemiology Department of Columbia, I think we're
13 getting ready to start a war.

14 THE COURT: Well, I -- I'll overrule your
15 objection. You can cross examine him on this, Mr. Farrell,
16 but I don't --

17 MR. FARRELL: Yes, Your Honor.

18 THE COURT: I'm going to let him go ahead.

19 Go ahead, Dr. Murphy.

20 BY MR. HESTER:

21 **Q.** Yes. Go ahead, Dr. Murphy.

22 **A.** You know, I think the algebra works the same in
23 economics and in epidemiology. They're both based on
24 mathematics and this is -- as you can tell, this is pretty
25 straightforward math.

1 **Q.** And let me ask you a question just to put that in
2 context. As an economist, do you undertake this kind of
3 effort to estimate populations? Is that something you do in
4 your work?

5 **A.** Sure. We do this all the time. We're trying to
6 estimate something, an input from an output or an output
7 from an input. You just do exactly this. If you know every
8 unit of input produces ten units of output, then you can
9 say, you know, input times how many units they produce
10 should be output and vice versa.

11 And if I know the output, I can say how much input do I
12 need by dividing.

13 **Q.** And so, I had asked you, did you reach an opinion about
14 the -- about whether Dr. Keyes reliably applied this basic
15 algebra to come up with an OUD population?

16 **A.** I did. And like I said, to make this work, you need to
17 have deaths for that population because if you have a
18 different number of deaths than the deaths that came out of
19 that population, obviously, this formula won't hold anymore.

20 And if you have the wrong mortality rate, then this
21 formula is not going to be reliable either.

22 So, if you mess those up, there's going to be a
23 problem.

24 **Q.** So, let me have you go back now, Dr. Murphy, to your
25 seat and I'll ask you a few more questions about that.

1 So, Dr. Murphy, you made the point that the methodology
2 depends -- the methodology for estimating the OUD population
3 depends on the accuracy of the death number and the
4 mortality rate. Did you reach a view as to whether Dr.
5 Keyes got these numbers right?

6 **A.** Right. Again, it's important. It's not that you have
7 a death, the right number of deaths. You have to have the
8 deaths for that population that you're trying to estimate
9 and you have to have the mortality rate that applies to that
10 population you're trying to estimate.

11 So, it's not just that you have the right number of
12 deaths from some other calculation. You need the right
13 number for this calculation, which means the deaths and the
14 mortality rates have to correspond to the population.

15 In this case, we're interested in estimating the OUD
16 population, so we need to have deaths for that population
17 and the right mortality rate for that OUD population.

18 **Q.** And did you reach a view as to whether Dr. Keyes came
19 up with the right death number for that estimation of the
20 OUD population?

21 **A.** I did. She -- she used all overdose deaths, which
22 would include people who don't have OUD. So, she's got
23 deaths in that death number that don't correspond to the
24 population she's trying to estimate.

25 **Q.** What's the significance of that point?

1 **A.** Well, as the formula kind of shows you, if you put too
2 many people in the death category, you're going to get too
3 many people implied in that population, right, because if
4 you're 10 percent too high on the deaths, you're 10 percent
5 too high on the population. It just carries straight over.

6 **Q.** Is it reasonable to assume that anyone who overdoses
7 from any drug has OUD?

8 **A.** No. It's certainly -- you know, somebody who overdosed
9 -- there's no reason to presume somebody who overdosed on a
10 non-opioid has OUD, but even there are going to be people
11 who overdose on opioids that don't have OUD.

12 **Q.** And does Dr. Keyes provide any support for the
13 assertion that everyone who overdoses from any drug has OUD?

14 **A.** No.

15 **Q.** You also testified that Dr. Keyes made an error in the
16 denominator in the mortality rate; is that right?

17 **A.** Yeah. She made several errors, actually, in
18 calculating the mortality rate.

19 One is she tries to calibrate the proper mortality rate
20 for the population using a calibration exercise based on
21 heroin and fentanyl deaths between 2011 and 2015, but she
22 doesn't do that correctly because she -- she comes -- she
23 basically looked at data and said that the death rate for
24 illicit opioids tripled over this period and then uses 3 as
25 the multiple for fentanyl mortality relative to -- to

1 non-fentanyl mortality basically in her formula.

2 But because 2015, not everything was fentanyl, that's
3 going to tend to underestimate the higher lethality of
4 fentanyl because, you know, it would only be equal to the
5 fentanyl mortality if you had a hundred percent shift. So
6 she's kind of missed on that one.

7 And then there's some other details of how she didn't
8 do it correctly either but, you know, that was probably the
9 biggest one on that dimension. So, mis-calibrated to the
10 2011, 2015 data.

11 And then, secondly, remember, I said you have to have
12 the right mortality rate for this population. And she's
13 applying this to deaths in -- in West Virginia, Cabell
14 County, and she's -- and, therefore, she's trying to
15 estimate the population of OUD in Cabell County.

16 In order to make this formula work, you have to have
17 the mortality rate for Cabell County for that population,
18 right? It doesn't work if you have the national one or
19 something that doesn't fit.

20 And because fentanyl grew much more in the east than in
21 the west, the mortality rate in Cabell County is higher than
22 you would think based on places where fentanyl was less part
23 of it.

24 **Q.** And does that point that you're making go back to the
25 graphs we looked at before where you showed that the level

1 of fentanyl mortality was much higher in the east of the
2 Mississippi states versus west Mississippi?

3 **A.** Yes. And, in fact, if you do that calculation that she
4 did, it's not the right calculation. So, if you just say
5 I'm going to do what she did and I'm just going to fix that
6 and I'm going to use 4.6 as the number which you would get
7 in the east of the Mississippi rather than 3, right, that
8 would be just fixing one.

9 You haven't fixed the numerator. You haven't fixed
10 deaths. You haven't fixed all this calibration stuff. You
11 just say I'm just going to change and say, look, the number
12 you need to use to fit the eastern data is much greater than
13 you need for the national data. So, I'm going to use 4.6,
14 which is the eastern number, as opposed to 3, which is the
15 national number.

16 Then what you do is, remember, she estimates, I
17 believe, 8252 as the OUD population. It goes down to like
18 5496.

19 **Q.** Now, I want to go back to that calculation in just a
20 minute, Dr. Murphy, and make sure we got that right, but at
21 a high level, first, is your view that the -- the errors by
22 Dr. Keyes affected both the deaths and the mortality numbers
23 that she relied on to estimate the OUD population?

24 **A.** Yeah. Her methodology overstates deaths, which is
25 going to push you toward higher population. Now,

1 overestimating the population and she tended to
2 underestimate the mortality rate, which also goes in the
3 same direction of pushing the population up.

4 **Q.** So, what's the net effect of those two errors that you
5 believe in terms of her OUD number?

6 **A.** The population she estimates is going to be too high as
7 a result of making errors in both increasing what we call
8 the enumerator, the top number, and decreasing the
9 denominator, or the bottom number.

10 **Q.** So, I want to go back now to this point you made about
11 the corrected calculations. Let's put aside these flaws of
12 -- the broader flaws of methodology you've discussed and
13 let's talk just about the fentanyl adjustment that Dr. Keyes
14 made.

15 Can you describe what she did? What was her
16 methodology?

17 **A.** Yeah. It's fascinating. She wasn't clear about what
18 she did in her report, but, I mean, I think it was clear
19 from her testimony she went to I think it was about -- I
20 can't remember who the paper was. She went to a paper and
21 she looked at illicit opioid mortality nationally and how it
22 changed between 2011 and 2015.

23 **Q.** Is that Dow (phonetic) you're thinking of?

24 **A.** Yeah, Dow. I knew it wasn't Powell. That's another
25 person. But it was Dow, that's correct.

1 And she estimated it. It roughly tripled over that
2 time period and she says, okay, I'm going to use that as the
3 effect of having a fentanyl in the supply rather than
4 non-fentanyl supply.

5 But then, when she applies it in her formula, she does
6 it in a way that would imply that that's the number
7 associated with fentanyl compared to non-fentanyl, which it
8 wouldn't be, because 2015 it wasn't a hundred percent
9 fentanyl. So, you know, the overall number is going to be a
10 weighted average. So, you would need a higher number for
11 fentanyl to fit the 2015 data if you did it correctly.

12 **Q.** And that's --

13 **A.** Now, she does a bunch of other stuff that's not right
14 either. She got weights by deaths instead of weights by
15 populations. And there's a lot of things that she kind of
16 messed up.

17 But if you just fixed that one, if you just said,
18 look, I'm going to do what she did and I'm going to put 4.6,
19 the number for the east rather than the 3 is the number for
20 the west. So, you haven't fixed even the way she did it,
21 just the number she plugged in.

22 **Q.** So, you're using this number 4.6. Where do you derive
23 that?

24 **A.** That's just to her methodology, but focused on the east
25 rather than west because, if you're going to calibrate out

1 for 2011 to 2015, remember, we need the mortality rate for
2 this population. We don't need the mortality rate for a
3 different population.

4 We need a mortality rate for the folks in West Virginia
5 if you're going to estimate OUD in West Virginia. And a
6 better estimate of that is going to be the eastern number
7 than it is the national number.

8 **Q.** And where -- and where does that 4.6 come from? Where
9 does that eastern number come from?

10 **A.** Do exactly what she did. Just estimate how much that
11 mortality went up between 2011 and 2015 and use that number.

12 **Q.** And so, if you put that 4.6 number in instead of the
13 3-times multiplier she used, what is the number that you
14 come up with in terms of an OUD?

15 **A.** I remember -- I believe her number was 8252. I think
16 the corrected number, just correcting that one thing, would
17 be 5496.

18 **Q.** And roughly how much smaller is that than Dr. Keyes'
19 estimate of the OUD population?

20 **A.** About a -- almost a third. About a third.

21 **Q.** Now, do you believe that that number that you just gave
22 us, 5496, is a reliable estimate of the OUD population of
23 Cabell-Huntington?

24 **A.** I don't think it is because we've still not corrected
25 the other flaws. We haven't corrected the deaths in the

1 numerator and we haven't corrected the other methodological
2 flaws in how she created her mortality rate.

3 Remember, all this depends on getting the right deaths
4 and getting the right mortality rates. If you don't have
5 them both, you're bound to not get the right answer. And I
6 think, just as that 4.6 number shows, it can lead to
7 substantial differences.

8 **Q.** So, but you're applying the 4.6 number the 5496 OUD
9 population that you've just given us? That assumes all of
10 the other elements of her methodology?

11 **A.** Correct. I just replaced number 3 with 4.6 in her
12 exact formula.

13 **Q.** Do you believe that that OUD number, 5496, is more
14 accurate than Dr. Keyes' estimate of 8252?

15 **A.** I would believe it would be more accurate, but it
16 wouldn't be something that I would be willing to rely on as
17 a -- as a number.

18 **Q.** As an economist, what conclusion do you draw from the
19 fact that making one adjustment like this in one assumption
20 on the geographic nature of fentanyl changes the OUD
21 estimate that much?

22 MR. FARRELL: Judge, I do think now we're probably
23 getting beyond the --

24 THE COURT: Yes. Do you want to remove the --

25 MR. FARRELL: Well, that, too.

1 THE COURT: I didn't understand what you said, Mr.
2 Farrell.

3 MR. FARRELL: Well, I think that now, this last
4 question, I think we now have gone beyond into the field of
5 epidemiology and that may be improper.

6 MR. HESTER: I mean, Your Honor, I was asking Dr.
7 Murphy his view as an economist.

8 THE COURT: Yeah. Overruled. I will allow it.
9 Go ahead.

10 BY MR. HESTER:

11 **Q.** Dr. Murphy, from your perspective as a professional
12 economist, what conclusion do you draw from the fact that
13 changing one assumption like this alters the estimate in
14 this -- by this magnitude?

15 **A.** Well, I think it's an illustration of how much those
16 assumptions matter. I mean, you know, sometimes you can
17 have an economic model or, you know, a model that's not
18 limited to economics in which changes in assumptions don't
19 matter very much. They somehow -- you know, they -- they're
20 not really a key driver of the output.

21 And what you illustrate with that example is that that
22 assumption in particular, which is not different than a lot
23 of the other elements of her analysis, has a substantial
24 effect. So, you worry that you got the numbers right.

25 **Q.** And so, does that bear on your judgment about the

1 reliability of her estimates?

2 **A.** Yeah. I think it would say given that I know that
3 there were a lot of things that were not done correct [sic]
4 and we really don't have the deaths or the mortality rate
5 for the population you're trying to estimate, I don't see
6 how you can make a reliable estimate.

7 MR. HESTER: Thank you, Dr. Murphy.

8 I'll pass the witness, Your Honor.

9 THE COURT: Okay. You may cross examine.

10 MR. FARRELL: Judge, is it possible for us to take
11 a five-minute break?

12 THE COURT: Yes. I think the court reporter will
13 appreciate that, too. Five minutes.

14 (Recess taken)

15 THE COURT: Okay, Mr. Farrell.

16 MR. FARRELL: Thank you.

17 **CROSS EXAMINATION**

18 **BY MR. FARRELL:**

19 **Q.** I introduced myself briefly. My name is Paul Farrell
20 and I've got some questions for you. Well, lesson number
21 one that I was taught by my elders is never debate economics
22 with an economist. So, what I do have is some general
23 broader questions that I want to walk through with you.

24 The first thing is, I went and typed in supply and
25 demand for kids and I came up with this graph.

1 MR. FARRELL: Can you put it up, please? The
2 supply and demand with the equilibrium, please. No, the one
3 before that. Yeah, this one.

4 BY MR. FARRELL:

5 **Q.** So, I promise I'm not going to embarrass myself by
6 going into too great detail, but I am trying to understand
7 your viewpoint as an economist in this case.

8 So, would you describe for the judge in general what
9 this is?

10 **A.** Well, as it's stated, it is a supply and demand
11 diagram. So, it says the quantity we get in the equilibrium
12 depends on the willingness of sellers in this case to supply
13 the product to suppliers and the willingness of buyers to
14 buy the product, which is the demand side.

15 So, you know, we usually think of, you know, maybe this
16 is gasoline and this is, you know, a quantity of gasoline on
17 the horizontal axis. Demand would be driven by how much
18 people want to drive and, you know, fuel economy of cars and
19 all kinds of things like that.

20 And the supply side would be determined by, you know,
21 availability of petroleum and the costs of refining and
22 things like that.

23 **Q.** So, in general, the blue line is the supply line,
24 correct?

25 **A.** That would be what we call supply curve.

1 **Q.** Supply curve. And it has a little bit of elasticity to
2 it?

3 **A.** It does. And it depends on -- how much elasticity
4 depends on lots of factors you can study in different
5 markets.

6 **Q.** So, I'm hoping to get some brownie points with the
7 terminology. But, in general, the supply curve on the
8 bottom, suppliers are willing to supply more quantity the
9 higher the price. Is that in general?

10 **A.** All else equal, yeah. I mean, you've got to be careful
11 to say why is the price higher but yes. I mean, all else
12 equal, suppliers will be more willing to supply the higher
13 the price.

14 **Q.** And, in general, consumers, or the people that are
15 demanding, they're willing to buy less the higher the price?

16 **A.** That generally is true, too. That's kind of called the
17 law of demand.

18 **Q.** And somewhere in between these two intersect in the
19 absence of government oversight in laissez faire economics
20 and they intersect at a natural market at an equilibrium
21 price, correct?

22 **A.** Yeah. Equilibrium would extend even if, for example,
23 there were taxes or other government interventions, they
24 might affect supply and they might affect demand, but you
25 still think there's an equilibrium, even when the government

1 is intervening. It's just a different equilibrium than you
2 would have absent government intervention.

3 MR. FARRELL: Now, could we go to the next slide?

4 Q. So, what I wanted to try to illustrate here is this is
5 the supply, but I've taken out the demand because the demand
6 for those that are addicted is a little different, is it
7 not?

8 A. Well, what do you mean by different? I mean, it still
9 obeys the law of demand. I mean, it still -- it still obeys
10 that they buy more when the price is lower and they buy less
11 when the price is higher.

12 In fact, the empirical evidence on addiction is
13 elasticity, it's not clear whether it's more elastic or less
14 elastic honestly.

15 I've actually written on this and Gary Becker and I
16 published papers on addiction. So --

17 Q. I'm aware.

18 A. Okay.

19 Q. In fact, you've said that there is more -- I'm not
20 saying absolutely an elastic, but you have said in your
21 papers that there is some inelasticity based on the nature
22 of addiction?

23 For instance, let me say it in a different way. If
24 you're addicted to opium you're probably going to want to
25 get your fix or get as much as you can no matter the price

1 until some ceiling, which makes the line maybe a little more
2 like that.

3 MR. HESTER: Your Honor, object to form. That's a
4 -- that's a long talk before a question.

5 THE WITNESS: I would say having studied
6 addiction, I don't think that's what the picture looks like.

7 BY MR. FARRELL:

8 **Q.** Okay.

9 **A.** If you look at cigarettes, it doesn't look like that.
10 We've done some work on -- on illicit drugs. They tend to
11 be inelastic, which means their elasticity is less than 1,
12 which means a 10 percent increase in price leads to a less
13 than 10 percent reduction in quantity. But that's not
14 unusual for non-addictive drugs.

15 For example, gasoline demand is very inelastic. That's
16 more like .1. It would be less than the elasticity of many
17 addictive substances.

18 So, I don't think -- you might want to say they
19 relatively tend to be inelastic, but that's not unusual.
20 All kinds of commodities have relatively inelastic demand.

21 **Q.** So, let's just take, say, heroin. Let's take an
22 addicted person to heroin or opium. What would the demand
23 curve look like?

24 **A.** It would be downward sloping. They would consume more
25 MMEs as MMEs get cheaper. And it wouldn't -- it would not

1 look like the one you drew because it wouldn't show a very
2 low price responsiveness typically.

3 **Q.** So, what would it look like?

4 **A.** It would -- it would tend to be like the standard
5 demand curve downward sloping. That, you know, people use
6 more as MMEs get cheaper.

7 That work's been done. A colleague of mine, Casey
8 Mulligan, for example, has done a lot of work looking at how
9 the price per MME has affected consumptions of MMEs and he's
10 -- you know, his analysis shows there's a significant price
11 response.

12 **Q.** And so, that's one of the points that you've made in
13 your papers, is it not, for the economic justification for
14 legalizing illicit drugs; is that fair?

15 **A.** Well, I think you're overly simplifying what we said.

16 **Q.** I'm sure I am.

17 **A.** I think we compared -- I think what we said is you
18 might want to make them legal and tax them rather than make
19 them illegal and have them taxed implicitly through
20 violence, and crime, and all those other things and having
21 them less safe because they're available on the streets.

22 And, you know, we saw that with prohibition. I mean,
23 we have prohibition on alcohol. It was just tremendously
24 disruptive. And there are lots of costs of having them
25 illegal.

1 I'm not saying you want to make them cheap and widely
2 available, but you don't -- I mean, illegal prohibitions,
3 ineffective prohibitions, are very costly because you end up
4 with all of these ancillary costs.

5 And, more importantly, you know, they end up being
6 ineffective. They're not great at reducing quantity. At
7 the same time, they're good at increasing lots of costs.

8 So, you know, we haven't had a great experience with
9 the war on drugs in my opinion. I think -- and people are
10 beginning to realize the kind of costs we've had. That
11 doesn't say you want unfettered access to things, but it
12 says the current methodology we're using isn't very
13 effective.

14 **Q.** And so, Dr. Murphy, let me see if I can be a little
15 more concise. You've written an article for The Wall Street
16 Journal and published at least three different times an
17 economic model suggesting that rather than arrest our way
18 out of the problem, it may be more beneficial to legalize
19 illicit drugs and regulate them; is that fair?

20 **A.** I think that's right. I think you would avoid the kind
21 of death rates we see today with illicit fentanyl where, you
22 know, people aren't out there trying to die by and large,
23 but because of the way they're supplied in a market that --
24 you know, where you have people buying things from -- they
25 have no recourse through the courts or anything else because

1 they're engaged in illegal transactions. The costs on the
2 consumers, as well as the communities and suppliers, are
3 going to be high. And that's why you want to get out of
4 that.

5 **Q.** Right. And so, I read your Wall Street Journal
6 article, but it's based on your papers and your papers use
7 an actual economic modeling system to make your point; is
8 that fair?

9 **A.** That is true.

10 **Q.** And it has a lot of formulas in it and it's pretty
11 complex but, theoretically, economists can come up with
12 modeling for this?

13 **A.** You can, but it's not just theoretical. I mean, it's
14 really -- a lot of it is empirical.

15 It's actually saying, look, I can link the theory to
16 the data. I can actually see the consequences of how a --
17 how a prohibition market works.

18 I can see the fact that the products that people get
19 are of inferior consistency and quality to what they would
20 get in a more standard marketplace. I can see that the
21 violence associated with contract enforcement or the lack of
22 contract enforcement in the illicit markets is a huge
23 problem.

24 You end up with all of these people in prison. Costs
25 them to be there. Costs us to put them there.

1 We have communities and countries kind of destroyed by
2 the illegal nature of the product. And those are high costs
3 that we pay as a society and as a -- really, as a population
4 in the world.

5 **Q.** Now, you also have noted in your writings that there's
6 probably some political opposition to legalizing illicit
7 drugs; agreed?

8 **A.** Oh, there is, although less. I mean, you know, it was
9 -- you know, if you thought about, you know, 30 years ago or
10 40 years ago, it wasn't very many people who, you know, even
11 thought marijuana should be legalized, right? We're moving
12 in that direction.

13 Guys like Milton Friedman were like, hey, you know,
14 this is a very costly system we have here and he was -- you
15 know, for long in that direction.

16 I mean, Gary Becker and I at the university and George
17 Schultz, who passed away recently, who was a good friend of
18 mine and Gary's, you know, these are all people who fought
19 thinking about these issues, seriously was a good idea that
20 -- that it was a way to potentially -- not that we wouldn't
21 be better off in a world where people didn't abuse drugs and
22 things like that. It's just, if you want to get there, the
23 way we're trying to get that isn't very effective.

24 **Q.** So, let me see if I can jump to a real quick topic
25 here. So, I'm going to try to take a non-graphic model and

1 just talk about supply and demand of opioids, right?

2 You've testified you have some basic knowledge but, in
3 general, you can't get addicted to an opioid unless you are
4 exposed to an opioid; would you agree with me?

5 **A.** Yes. I mean, to consume an opioid you have to consume
6 it and generally it's hard to get addicted to something
7 without consuming it first. Addiction tends to follow
8 consumption.

9 **Q.** Okay. In this instance, it's impossible to get
10 addicted to opioids unless you have been exposed to opioids;
11 agreed?

12 **A.** I think that's right. I'm not a doctor, so I can't
13 say, but that's my understanding of how it works. It's
14 addictions driven through past consumption.

15 **Q.** Okay. So, if you supply somebody with an opioid and
16 they consume it and become addicted to it, that also tends
17 to generate demand; would you agree with that?

18 **A.** Well, it generates -- it could generate future demand;
19 that is, there's some feedback effect, but past demand would
20 also generate future demand. Again, it's consumption that
21 generates future demand, not supply. Right? It's
22 consumption that generates future demand in an addiction
23 framework.

24 **Q.** So, instead of demand, if we just put here "patient",
25 and instead of supply, we put a "pharmacy", right, what I

1 want to ask you is this -- you're shaking your head no.

2 **A.** I don't -- I don't see how those are analogous, how
3 pharmacies telling me just about supply and how a patient is
4 telling me just about demand. So --

5 **Q.** Well, I'm attempting to change the diagram. The
6 pharmacy supplies pills to patients, correct?

7 **A.** Yeah, but not in the economic sense. I mean, they're
8 not the determinants on the supply side, right?

9 **Q.** Yeah. So, this is where I'm going with this. I'm
10 trying to go through the closed chain of distribution in the
11 Controlled Substance Act and you're here today talking about
12 supply and demand from an economic standpoint and what are
13 the driving factors as if we're in graduate school at the
14 University of Chicago studying markets; agreed?

15 MR. HESTER: Your Honor, I object to the question.
16 It's just argumentative.

17 THE COURT: Sustained.

18 MS. HARDIN: Join, Your Honor.

19 THE COURT: Sustained.

20 MR. FARRELL: I thought it was a pretty good
21 argument.

22 THE COURT: Well, but --

23 BY MR. FARRELL:

24 **Q.** So, in general, you understand that patients go to
25 pharmacies to get their prescriptions filled?

1 **A.** That's true.

2 **Q.** And in order to do so, they have to go see a doctor
3 first and get a prescription? You understand that?

4 **A.** Yes.

5 **Q.** And that pharmacies have to buy their pills from
6 distributors? Do you understand that?

7 **A.** Yeah. I mean, although it's a little complicated
8 because the pharmacies also have deals with the
9 manufacturers, right, because --

10 **Q.** Well, it's just --

11 **A.** No. I'm just saying the distributors in this industry
12 are a little different than distributors in other industries
13 because the pharmacies actually have direct relationships
14 with the manufacturers and the distributors really handle
15 the distribution part, not the contracting part often with
16 the pharmacies. I think that's a little different than, for
17 example, most wholesale distribution models.

18 **Q.** Agreed. I'm not going to dispute any of that.

19 Here's the point that I'm going to try to make. Have
20 you made any attempt to assess in your analysis the duties
21 imposed by the Controlled Substances Act between the
22 distributors and the pharmacies?

23 **A.** I have not offered an opinion on the regulatory
24 environment or the legal. Those are outside of my areas of
25 expertise.

1 **Q.** One last follow-up on this. If we have the supply and
2 demand and let's just say that here's the demand and here's
3 the supply, is there some terminology in economics where the
4 federal government, through regulation or otherwise, comes
5 in and tries to limit the amount of supply -- that's not
6 working very well -- tries to limit the amount of supply by
7 putting some type of cap on it?

8 **A.** Sometimes, but that would be a price cap, the way
9 you're drawing it, I think, but yeah.

10 **Q.** Okay. Well, how would you account for the supply and
11 demand in the field of opioids for the government's rules
12 for the distributors to block suspicious orders? How would
13 you account for that in economic terms?

14 MR. HESTER: Object to form, Your Honor.

15 MS. HARDIN: Same, Your Honor.

16 THE COURT: Yeah. I think the question is
17 confusing, Mr. Farrell. I'll sustain the objection.

18 BY MR. FARRELL:

19 **Q.** Is there any way for an economist to build into your
20 analysis rules on what limits supply?

21 **A.** I would say yes, that economists can look at -- so, for
22 example, we know here that the drugs that were delivered
23 were delivered pursuant to prescriptions.

24 THE COURT: Mr. Farrell, how much more are you
25 going to have?

1 MR. FARRELL: We can take a lunch break.

2 THE COURT: We can what?

3 MR. FARRELL: Take a lunch break.

4 THE COURT: Well, are you going to have -- we're
5 not going to be able to finish with Dr. Murphy in the next
6 few minutes, are we?

7 MR. FARRELL: If you give me a few seconds to
8 whisper, I'll have a few questions.

9 THE COURT: Do you have any re-direct at this
10 point, Mr. Hester?

11 MR. HESTER: Not at this point, Your Honor.

12 THE COURT: Okay. Maybe we can finish up here.

13 (Pause)

14 MR. FARRELL: Judge, I'm advised we should take a
15 lunch break.

16 MR. HESTER: Your Honor, there is one thing I
17 should say, though. Dr. Murphy has a commitment in another
18 matter where he has to testify tomorrow and I assume you're
19 not going to go the full afternoon, but I wanted to check.

20 MR. FARRELL: I'm certain of it.

21 THE COURT: What is the time you're trying to get
22 out of town, Dr. Murphy?

23 THE WITNESS: I have a flight at 6:00 p.m.

24 MR. HESTER: So, I think we're fine, as long as
25 it's not going to be a long process.

1 THE COURT: Okay. I'm going to ask you to come
2 back at 2:00, Dr. Murphy, and we'll be in recess until 2:00.

3 (Recess taken)

4 THE COURT: Good afternoon, Dr. Murphy.

5 THE WITNESS: Good afternoon, Your Honor.

6 THE COURT: Okay, Mr. Farrell, you may continue.

7 MR. FARRELL: Can we bring up the Exhibit 1 from
8 the demonstratives the defendants used, please? There we
9 go.

10 BY MR. FARRELL:

11 Q. Dr. Murphy, I have a couple of questions, and some of
12 this is just orientation to make a couple of subtle points.
13 This is Exhibit 26 from your report and I want to first come
14 over here and I'm going to draw a little square around MME
15 per adult. Do you see that?

16 A. Yes, I do.

17 Q. Okay. What's your understanding of what MME per adult
18 means?

19 A. It's a morphine equivalent measured on a per adult per
20 year basis. So, it's --

21 Q. And this is -- would another word be -- for it the
22 weight of the drug or how much of the -- of the morphine
23 milligram equivalent is present?

24 A. Yeah. It's the equivalent amount of weight measured in
25 morphine equivalence. So, it's not the weight of the actual

1 drug. It would be translated to morphine equivalence
2 weight.

3 **Q.** And this comes from the ARCOS data, correct?

4 **A.** That does come -- well, yes. The blue line comes from
5 the ARCOS data.

6 **Q.** And so, this would be a measurement, for a lack of a
7 better word, of volume? Would you agree with that?

8 **A.** It would be a measure of volume, right. There's other
9 things you could do, but I think this has become kind of the
10 most common measure of volume for this marketplace.

11 **Q.** And so, in particular, what you've measured here is
12 prescription opioid by volume; agreed?

13 **A.** For West Virginia by year per -- measured on a per
14 adult basis.

15 **Q.** Yes, sir. And then the line though here, this line,
16 this black line, is all opioid deaths; agreed?

17 **A.** That's correct.

18 **Q.** So, it would include prescription opioids and, say,
19 heroin or fentanyl?

20 **A.** Yes. It would be all opioid deaths, as well as
21 combinations of those, like I talked about earlier.

22 **Q.** And so, the purpose of this graph is to demonstrate
23 that there was a period of time where the volume of
24 prescription opioids into West Virginia correlated to a
25 parallel track of opioid deaths, more or less; agreed?

1 **A.** Yeah. They were both going up in that earlier period.
2 Parallel is harder to say from this graph, but they were
3 both going up.

4 **Q.** And so, here's ultimately, I guess, what my question
5 is. Right here at this point, this inflection point, you'll
6 agree with me that something happened?

7 **A.** Well, yeah. I mean, but you circled that whole later
8 period. So, the point at which something happens is kind of
9 where things turn. Not where they cross. I don't think
10 where they cross is of particular significance.

11 **Q.** So, somewhere in here?

12 **A.** Well, which line are you referring to, the blue one or
13 the black one?

14 **Q.** Well, I think I'm just talking about in general, that
15 the prescription opioids are going down and the deaths are
16 going up. They've changed courses. Something has changed.

17 **A.** Right. The only thing I was referring to is usually
18 when you talk about an inflection point, it's not a range.
19 It's a point.

20 **Q.** Yes, sir.

21 **A.** So, you would typically say there was some kind of
22 inflection. That term is misused because, in mathematics,
23 inflection actually means something different.

24 What we're really talking about is the turning point in
25 that blue line from rising to falling. And then, the black

1 line is kind of an acceleration that happens in that black
2 line later.

3 **Q.** So, my question to you is this. Do you believe that
4 people addicted to prescription opioids have been
5 transitioning to heroin?

6 **A.** Some have, but not as a population as a whole. There
7 have been some people transition.

8 **Q.** Is this from -- from your personal knowledge or from
9 your academic knowledge as an economist?

10 **A.** This would be from reading the literature out there and
11 looking at the data. The data I analyze in my report
12 doesn't specifically follow individuals, although a lot of
13 the papers and other things I've looked at in the academic
14 literature look more at individuals. And you do see some
15 individuals moving across those categories.

16 **Q.** So, you understand, sir, that there is testimony and
17 scientific literature in the record to suggest that there is
18 a strong correlation between prescription opioid misuse and
19 the initiation of heroin?

20 MR. HESTER: Object on foundation grounds, Your
21 Honor.

22 THE WITNESS: Most of the studies don't actually
23 look at that.

24 THE COURT: Just a second.

25 I'll overrule the objection. Go ahead.

1 THE WITNESS: I'm sorry. I'm sorry. I should
2 have waited.

3 Most of the studies that I look at don't really look at
4 that correlation. They actually look at people who initiate
5 heroin and ask what fraction of those previously used
6 prescription opioids, which is not an association, right?
7 It's -- because it's not how is one related to the other.
8 It's just a conditional probability in that direction.

9 Q. So, you understand that the medical literature and the
10 testimony that has been introduced in this court is that
11 four out of five heroin users previously used or abused
12 prescription opioids?

13 A. It depends on what time period you're looking at.
14 That's changed dramatically, for example, in recent years
15 where a lot more people are initiating on heroin now who
16 haven't previously used prescription opioids.

17 Q. And you --

18 A. So, you've got to be careful in terms of what time
19 period you're talking about.

20 Q. Yes, sir. All right. So, let me change it around and
21 put it in a different perspective just to make a theoretical
22 point. I would like for you to assume that four out of five
23 people that use heroin started out on prescription opioids.
24 Can you assume that for me?

25 A. Please define what you mean by started out. That's the

1 first drug they took?

2 **Q.** All right. And so, let me start it another way. I
3 want you to assume that there is a relationship, a gateway,
4 a transition, between abusing prescription opioids and using
5 heroin. I want you to assume that as a fact, okay?

6 **A.** Define what you mean by gateway because it's been used
7 and misused in these discussions. So, you need to define
8 what you mean by gateway.

9 **Q.** Yes, sir. We've had about 30 days worth of debate on
10 it and I fully understand that. What I'm trying to simply
11 do is have you assume that the body of evidence or the
12 argument establishing a gateway effect is, in fact, true.
13 It doesn't mean you have to agree with it. I just want you
14 to assume that as a fact.

15 **A.** I just want you to define when you say the evidence has
16 found a gateway. Tell me what you mean constitutes a
17 gateway. Does that mean if you're saying -- are you saying
18 a number of the people who start on heroin have previously
19 used prescription opioids? In no scientific sense would you
20 say that's a gateway. If that's what you mean by gateway,
21 that's not a gateway.

22 **Q.** Yes, I understand. I want you, whatever framework you
23 want to use for gateway, whatever level of evidence, I want
24 you just to assume for a moment that people that use
25 prescription opioids are going to end up using heroin.

1 How's that?

2 **A.** Okay. That's counterfactual, but --

3 **Q.** It's theoretical and it's hypothetical. If that's
4 true, then you would also agree with me that -- from your
5 testimony that the heroin east of the Mississippi is more
6 likely to have fentanyl; agreed?

7 **A.** I think in recent years, in particular. It wasn't true
8 always, but in recent years, more likely than heroin east of
9 the Mississippi would contain fentanyl.

10 **Q.** And I want you to assume that fentanyl laced heroin is
11 causing fatal overdoses, particularly east of the
12 Mississippi. I want you to assume those three facts.

13 My question to you, sir, is if you assume those three
14 facts are true, does that not, in fact, explain the change
15 in the trajectory on Exhibit 26?

16 **A.** I -- you're asking does that explain the actual world
17 or could you construct a world where that would happen?

18 **Q.** I'm just asking you. You said that something happened.
19 There's lots of factors involved. And I'm asking you, if
20 you assume those three facts to be true, whether or not that
21 is an explanation for the change we see in Exhibit 26
22 between the volume of prescription opioids and the number of
23 fatal overdoses from opioids?

24 **A.** I would say you could construct such a world. I don't
25 think it fits the actual world. That's -- there are too

1 many other things that don't fit with that.

2 MR. FARRELL: Can we go to Slide 5, please?

3 BY MR. FARRELL:

4 Q. So, I wanted to discuss with you very briefly again the
5 scatter diagram and to make sure that we are on the same
6 page.

7 This is heroin mortality between 2010 and 2018 on the
8 left and fentanyl mortality between 2013 and 2018 on the
9 right by state, correct?

10 A. Those are the vertical axes. The horizontal axes are
11 the -- in both cases are what it says.

12 Q. And so, what your ultimate point here is, is that if
13 you take the average prescription opioid shipment over time
14 and put it on a scatter diagram with the number of deaths,
15 you're saying that the disparity or that the spread of this
16 data indicates a weak association? That's your ultimate
17 point, correct?

18 A. Yeah.

19 Q. So --

20 A. Not just the dots, but the statistics both suggest a
21 weak association.

22 Q. Yes, sir. In economic terms?

23 A. Probably more statistical terms, to be honest, but yes,
24 we can call it economics.

25 Q. Yes, sir. But, ultimately, if you take the dot here

1 for heroin mortality what we can draw from this is that West
2 Virginia is at the higher end of the rest of the country for
3 heroin mortality; agreed?

4 **A.** Yes. You know, I don't know what number it is. Over
5 this period, on average, it was in the top group.

6 **Q.** And the same thing over here with fentanyl, is West
7 Virginia is at what appears to be on your graph the second
8 highest fentanyl mortality in the country; agreed?

9 **A.** That's what it appears. I believe that's correct.
10 That's what it says in the graph.

11 **Q.** Now, if we go to the next slide, which is Page 6, and
12 the last -- the last one that we'll discuss, and I'm not
13 going to bother erasing it because I know I'll mess it up.
14 But in general -- I wrote this down.

15 Correct me if I'm wrong, but what you are -- is the
16 purpose of this slide or is it your testimony that the
17 people that are getting the pills are not the people dying
18 from the pills? Is that a fair assessment as to what your
19 opinion is today based on the statistics?

20 **A.** Well, in this graph, we're looking at people getting
21 the prescriptions and people -- in that previous period and
22 people dying from illicit opioids in a later period. That's
23 how I would put it.

24 **Q.** So, let me rephrase it. The people that are getting
25 the prescriptions are not the people that are dying of

1 opioid overdoses later? That's your -- that's your
2 position?

3 **A.** Yeah. I mean, that was paraphrasing, yes.

4 **Q.** So, could it also be, in a theoretical sense, could an
5 explanation for that be that the pills that people are
6 getting by prescription are diverting it to the black
7 market? Is that a theoretical possibility?

8 **A.** It is. That's why I did the other graph.

9 **Q.** And so, is that not just a theoretical possibility but,
10 in fact, is that your -- your conclusion as an economist
11 that the pills, the prescription pills that were given to
12 patients with prescriptions in their hand, were more likely
13 than not diverting those pills to others that were then
14 overdosing on licit and illicit opium?

15 **A.** I am not saying that because I don't think it's more --
16 I don't have any evidence to say that it's more likely than
17 not that that's where those pills were going. I don't think
18 we have an idea of the fraction that they're going to other
19 people.

20 **Q.** But that -- but to be fair, your position is, is that
21 there's something to be said, there is an explanation for
22 why it is that people that are receiving the prescriptions
23 aren't the ones that are dying from the prescriptions?

24 **A.** Well, you can't read this graph that way because I
25 seriously doubt that the pills that these people got from

1 prescriptions in 2001 to 2002 are leading to heroin and
2 fentanyl deaths for people ten years later.

3 I mean, those pills, they transformed from prescription
4 opioids to heroin and fentanyl and then were ingested by
5 people a decade later, is that what you're saying, because
6 that's what's on this graph?

7 **Q.** No, no. No, no. Let's put this graph aside.

8 I'm asking you, sir, based on your review, do you think
9 that there was a substantial amount of prescription opioids
10 that were diverted in Huntington, Cabell County, West
11 Virginia from the people who originally presented the
12 prescription?

13 **A.** My -- I haven't done the study of that, but my
14 understanding is that there were diversions from the pills
15 after those prescriptions were filled and there was also
16 abuse by people who received those prescriptions both.

17 **Q.** Thank you.

18 MR. FARRELL: Judge, may I have a moment?

19 THE COURT: Yes.

20 (Pause)

21 MR. FARRELL: That's all the questions I have,
22 Doctor. Thank you for coming to West Virginia. It was a
23 pleasure to meet you.

24 THE WITNESS: Thank you so much.

25 THE COURT: Mr. Hester, do you want to re-direct?

1 MR. HESTER: Just one -- just one point, Your
2 Honor.

3 **REDIRECT EXAMINATION**

4 **BY MR. HESTER:**

5 **Q.** Dr. Murphy, Mr. Farrell asked you some questions about
6 an assumption that four out of five people who are heroin
7 users began by misusing prescription opioids. Why would
8 that not be sufficient, in your view, to conclude that
9 prescription opioid misuse is a gateway to heroin?

10 **A.** Because it simply says a lot of people -- a lot of the
11 people who ended up on heroin previously did something. Let
12 me replace assuming prescription opioids with drinking
13 water. Basically, a hundred percent of the people who
14 initiated on heroin previously drank water. That just -- it
15 doesn't -- that's not looking at the probabilities the right
16 way.

17 There's also a serious problem with the -- with the
18 theory because let's assume that there are people who move
19 from prescription opioids to heroin and when -- when
20 prescription opioids become less available, but what will
21 happen if you made prescription opioids less available, more
22 people initiate directly on heroin. You might actually end
23 up with more people on heroin, not fewer. That's a problem.

24 And the plaintiffs' experts in this case don't talk
25 about that at all. And that, in fact, is not a theoretical

1 possibility, but an actual reality that, as the availability
2 of the prescription opioids have gone down, more people now
3 initiate on heroin. You could actually end up with more
4 people on heroin. And you have to take account of that
5 pathway.

6 The second thing I would say is the fact that people do
7 A and B doesn't mean there's a gateway or that they move
8 from A to B when one becomes less available.

9 Give you an example. Think about Coke and Pepsi. What
10 would happen if we reduced the availability of Coke? I mean
11 Coca-Cola, not the other kind of coke. More people would
12 drink Pepsi. People who used to drink Coke will start
13 drinking Pepsi.

14 That doesn't mean there's a gateway from Coke to Pepsi.
15 It doesn't mean if we didn't have Coke around, there would
16 be fewer people drinking Pepsi. There would be more people
17 drinking Pepsi if we didn't have Coke because they wouldn't
18 be able to drink Coke.

19 The point is that this evidence that people move from A
20 to B when A becomes less available, in economic terms, that
21 just means there are substitutes. It doesn't tell you it's
22 a gateway.

23 **Q.** And so, let me ask a few questions to follow up on
24 that, Dr. Murphy. Is your point that if you simply observe
25 a temporal sequence or a sequence of events, somebody uses

1 or misuses one drug and then subsequently misuses another
2 drug that you cannot infer a gateway from that temporal
3 sequence of events?

4 **A.** Exactly. And you can't because -- for exactly the
5 reasons I talked about. There's several ways that will
6 happen.

7 One is that you're looking at people who have a
8 propensity to do both. So, often, they'll do A before B.

9 The second one is they can just -- you know, you can
10 have the kind of situation that I talked about with the Coke
11 and Pepsi.

12 **Q.** I want you to build on this point. Are you aware of
13 evidence suggesting that people who misuse or abuse
14 prescription opioids before they abuse heroin also have
15 abused other substances?

16 **A.** Yes. That -- the evidence is very clear on that, that
17 many of those who, you know, it was mentioned abused
18 prescription opioids before they used heroin also abused
19 other drugs.

20 **Q.** What's the significance of that point?

21 **A.** Well, it gets back to economics because, when it gets
22 back to the economics, it's that some people are prone to
23 abuse and they'll abuse prescription opioids if they're
24 available. If they're not available, they'll abuse
25 something else. Or maybe they'll abuse multiple drugs.

1 And in some of the patterns we observe of people doing
2 multiple things in sequence or at the same time reflect
3 those differences across individuals and you have to take
4 that into account.

5 **Q.** In particular, why would it be relevant if people have
6 abused other substances before abusing prescription opioids
7 and before abusing heroin? Why would that be relevant in
8 assessing the gateway?

9 MR. FARRELL: Objection, Your Honor. I think this
10 goes far afield of the Economic School of Chicago. This is
11 back into epidemiology, as well as the evidence we heard
12 from several other experts.

13 THE COURT: Overruled.

14 Go ahead, Mr. Hester.

15 THE WITNESS: I would say it gets to this -- two
16 things. One is differences across people and the propensity
17 to use drugs of different types. And, also, it gets to this
18 substitute concept, that simply seeing people switch from
19 one to the other or when one becomes less available moves to
20 the other tells us two things.

21 One is that there are people who have a propensity to
22 do both. And, two, it tells us that one is a substitute for
23 the other. If I can't get one, I'll do the other one, kind
24 of like my Coke and Pepsi example.

25 **Q.** And so, is your point that substitutes are not the same

1 as gateways?

2 **A.** No. You can have, in fact, substitutes have -- often
3 have nothing to do with gateways.

4 MR. HESTER: Thank you, Dr. Murphy. Those are all
5 the questions I have.

6 THE COURT: Anything else, Mr. Farrell?

7 MR. FARRELL: Yes, sir.

8 **RECROSS EXAMINATION**

9 **BY MR. FARRELL:**

10 **Q.** Dr. Murphy, you understand that prescription opioids
11 and heroin have the same molecule, same molecular structure?
12 They both -- they both are from the morphine molecule?

13 **A.** I understand that; not from my economics training,
14 however.

15 **Q.** Yes, sir. So, from an economics standpoint, is it fair
16 to say that prescription opioids and heroin are substitutes
17 for each other?

18 **A.** You would -- in economics, you always have to be
19 careful. That would be a factor making me think they would
20 be substitutes. I think we generally look for empirical
21 evidence that they are substitutes because you can come up
22 with examples that look like they would be substitutes and
23 turn out to be complements. I teach a whole lecture on that
24 in my class. I don't want to bore you with that today.

25 **Q.** I certainly don't want to get bored with it. So, your

1 testimony is that heroin and prescription opioids are
2 empirically substitutes?

3 MR. HESTER: Your Honor, I believe that misstates
4 his testimony.

5 THE WITNESS: I will clarify it.

6 THE COURT: Just a minute. Just a minute.

7 Well, I'll let him answer. Go ahead.

8 MR. FARRELL: It had a question mark at the end.

9 BY MR. FARRELL:

10 **Q.** I'm asking you --

11 **A.** You know, I -- I would say if you focus on abuse of
12 prescription opioids and abuse of heroin, they're probably
13 closer to be substitutes. I think heroin is less --
14 probably not really a substitute for legitimate use of
15 prescription opioids. It's -- you know, people don't
16 substitute much on that margin.

17 MR. FARRELL: Very good. Thank you.

18 THE COURT: What's the difference between
19 substitute and a complement? I think I missed that part.

20 THE WITNESS: A complement are two things that get
21 used together, like tennis ball and tennis rackets. That
22 would be a complement.

23 And substitute would be like Coke or Pepsi. I like
24 cola. I can drink Coke or I can drink Pepsi.

25 THE COURT: Okay.

1 Anything else of Dr. Murphy?

2 MR. HESTER: No, Your Honor. Thank you.

3 THE COURT: Dr. Murphy, thank you, sir, very much.

4 I hope you have a good trip out of town and it's been a
5 pleasure having you here. Thank you, sir.

6 THE WITNESS: Thank you so much, Your Honor.

7 THE COURT: Yes, ma'am?

8 MS. MAINIGI: Your Honor, I think there is another
9 witness coming this afternoon, but I just wanted to go ahead
10 and alert the Court, much as I did last week, about where we
11 stand, the defendants in our schedule.

12 I think that we may -- we're moving quickly and we're
13 skinning down a little bit. So, I think we may be done as
14 early -- depending on the length of cross examinations, as
15 early as the middle of next week. I've alerted the
16 plaintiffs to that fact.

17 We're going to be spending some time in the next day or
18 two as a group working through the remainder of our
19 witnesses and I think right now the plaintiffs have notice
20 per our various stipulations of who we are intending to
21 call. Some folks may drop off that list.

22 What we would propose, Your Honor, is that after we've
23 had a chance to further confer that we speak to the
24 plaintiffs tonight and perhaps come to Your Honor with a
25 proposal for timing of closings and findings of fact,

1 conclusions of law, and perhaps we could spend some time on
2 that tomorrow.

3 I do think that since we are moving so quickly and we
4 moved through more quickly than expected on some of the --
5 these witnesses that we may end up ending a little earlier
6 today. The witness that we have after the next witness
7 can't be here until tomorrow.

8 I think that might be our only witness tomorrow. So,
9 we may end a little earlier tomorrow, too, which I think
10 would be welcomed by everyone in this courtroom.

11 And then, we also -- I don't want to forget that we
12 also have depo designations, of course, that we'll continue
13 to work through that we'll submit to the Court next week.
14 So --

15 THE COURT: Well, that's all welcome news, Ms.
16 Mainigi. You mentioned proposed findings and conclusions.
17 You submitted those a long time ago but, obviously, they'll
18 be --

19 MS. MAINIGI: Updated.

20 THE COURT: Updated based on what's happened
21 during the course of the trial, so I can look forward to
22 getting new ones then.

23 MS. MAINIGI: Ultimately, yes, Your Honor. Yes.
24 Exactly right.

25 THE COURT: Okay. Well, that all sounds good.

1 MS. MAINIGI: I thought Your Honor and this Court
2 might appreciate that news.

3 THE COURT: I'm looking for an appropriate word.

4 (Laughter)

5 MS. MAINIGI: Well, that's all I have for today,
6 Your Honor. I think we've got one more witness and, as I
7 said, it's possible that we may not go to the end of today.

8 THE COURT: Are we ready to go with that other
9 witness or do we need to take a break?

10 Ms. Wu?

11 MS. WU: Yes, Your Honor. We'll just get the
12 witness.

13 THE COURT: Okay. Very good.

14 COURTROOM DEPUTY CLERK: Sir, please state your
15 name.

16 THE WITNESS: Peter Boberg.

17 COURTROOM DEPUTY CLERK: Thank you. Please raise
18 your right hand.

19 **PETER BOBERG, DEFENSE WITNESS, SWORN**

20 COURTROOM DEPUTY CLERK: Thank you. Please take a
21 seat.

22 THE COURT: Good afternoon, sir.

23 THE WITNESS: Good morning, Your Honor. Or good
24 afternoon rather.

25 MS. WU: May we proceed, Your Honor?

1 THE COURT: Yes, please.

2 MS. WU: Thank you.

3 **DIRECT EXAMINATION**

4 **BY MS. WU:**

5 **Q.** Doctor Boberg, would you please introduce yourself to
6 the Court?

7 **A.** Yes. Good morning. My name is Peter Boberg.

8 **Q.** Doctor, how are you currently employed?

9 **A.** I'm an economist at Charles River Associates.

10 **Q.** What is your understanding of why you're here to
11 testify today?

12 **A.** I was asked to look at the flagging analysis of --
13 performed by Dr. McCann on the ARCOS data and testified to
14 and relied on by Mr. Rafalski.

15 **Q.** Now, Doctor, before we go into your qualifications, I
16 want to briefly orient the Court to the opinions that you're
17 going to get into in more detail.

18 What are the flagging methodologies that you just
19 referenced?

20 **A.** Dr. McCann developed six methodologies that he applies
21 to ARCOS shipment data from distributors to pharmacies in
22 Cabell County and Huntington, West Virginia and he applies
23 the algorithms to flag shipments that he believes were
24 caused suspicious or unlawful.

25 **Q.** Thank you, Doctor.

1 MS. WU: Mr. Reynolds, could we please put up
2 Rafalski Demonstrative 223 at Page 14? I'm putting this up.
3 This will refresh us on some testimony which was provided
4 earlier in the case.

5 BY MS. WU:

6 **Q.** Doctor Boberg, are the six methodologies identified in
7 this demonstrative those that you were asked to review in
8 connection with your work in this case?

9 **A.** Yes, they are.

10 **Q.** What specifically were you asked to review with regard
11 to these methodologies presented by Mr. Rafalski?

12 **A.** I was asked to review the methodologies to make sure I
13 understood how Dr. McCann implemented the algorithms and
14 then to assess the reliability and validity of the results
15 he obtained using those algorithms.

16 **Q.** Doctor, you just mentioned Dr. McCann, who testified
17 earlier in this trial. Is it your understanding that Dr.
18 McCann did the modeling work that Mr. Rafalski relied on to
19 present these six methodologies to the Court?

20 **A.** Yes. That's correct.

21 **Q.** What did you conclude about the reliability of these
22 six methodologies presented by Mr. Rafalski?

23 **A.** After studying the methodologies, I found the results
24 to be unreliable and invalid. And that was really for three
25 main reasons.

1 One, I found the results to be lacking in robustness.
2 They're driven almost entirely by a single assumption for
3 which Dr. McCann doesn't provide any basis. And when I
4 remove that assumption, the results essentially go away.

5 Second, I find that they're inconsistent across the
6 different methodologies. So, running methodologies that
7 ostensibly do the same thing, they achieve very different
8 results and that suggests they're unreliable.

9 And, third, I looked at the results and compared them
10 to other evidence. In particular, I looked at the DEA's
11 estimates of the actual rate of diversion out of the
12 controlled channel and found Dr. McCann's estimates were
13 very, very different than the DEA's estimates and so,
14 concluded that his results were unreliable.

15 **Q.** Okay. So, I want to unpack those just very briefly for
16 the Court's benefit. You mentioned assumptions. How do the
17 assumptions used in these models relate to your opinion
18 about the reliability or lack thereof of these
19 methodologies?

20 **A.** Well, as I said, the assumptions that Dr. McCann makes,
21 he assumes that after a shipment is flagged every subsequent
22 shipment must also be flagged and he really provides no
23 basis for that. He didn't investigate whether that
24 assumption was valid or true and, yet, it drives almost all
25 of his results. And so, I find that makes his results

1 unreliable.

2 **Q.** You also mentioned that these six results presented by
3 Mr. Rafalski have inconsistent results. How does the
4 inconsistency in those results impact your determination
5 that the methodologies are unreliable?

6 **A.** Well, when I find that Dr. McCann's results as flagging
7 72 percent of shipments as unlawful using Method A, but only
8 28 percent, for example, using Method B, you know, both
9 numbers can't be right. Both sets of flagged shipments
10 can't -- you know, it can't be correct.

11 Dr. McCann provides no guidance about which one is
12 correct or a framework with which to evaluate which one is
13 correct. And so, that -- really, that inconsistency means
14 the results are unreliable.

15 **Q.** Now, the last critique that you offered in brief is
16 that the results of Mr. Rafalski's six methodologies are
17 unrelated to real world information. Can you explain that
18 for the Court?

19 **A.** Yes. I saw that Dr. McCann was flagging a very large
20 percentage of shipments into Huntington and Cabell County as
21 unlawful and suspicious and I wanted to know, you know, is
22 that -- is there some evidence that helps us understand
23 whether that's a reliable estimate.

24 And the DEA does determine the level of diversion out
25 of the controlled channel as part of its obligations. And

1 that level is very, very low. It's about .1 percent in the
2 case of oxy and hydro and that just doesn't compare with
3 what Dr. McCann's findings -- his -- his flagging is far in
4 excess of that. And so, I find that's unreliable.

5 **Q.** Thank you, Doctor.

6 MS. WU: Mr. Reynolds, we can take down the
7 demonstrative.

8 BY MS. WU:

9 **Q.** Dr. Boberg, were you also asked to perform some
10 analyses that are specific to McKesson?

11 **A.** Yes, I was.

12 **Q.** And what analyses were you asked to perform?

13 **A.** I was asked to look at McKesson's market share in
14 Huntington and Cabell County and look at Dr. McCann's
15 calculation of that market share.

16 **Q.** Thank you, Doctor. So, now that we've provided an
17 overview of your opinions in this case, let's talk about
18 your qualifications.

19 How would you describe the expertise that you bring to
20 the work that you have done for this case?

21 **A.** Well, most of my work involves applying economics and
22 econometrics in the principles of data analysis to various
23 settings. So, sometimes that's in litigation cases in
24 courts like this one. Most often, it's before regulators
25 like the Federal Trade Commission or the Department of

1 Justice.

2 **Q.** Doctor, how did you become an expert in econometrics
3 and data analysis?

4 **A.** I received my Ph.D. in Economics from the University of
5 Michigan. Prior to that, a Bachelor's in Economics from the
6 University of Alberta in Canada. And then, after my Ph.D.,
7 I joined Charles River Associates, where I've been for the
8 last 21 years.

9 **Q.** What is Charles River Associates, or CRA, as sometimes
10 we refer to it?

11 **A.** It's an economic consulting firm based in Boston.

12 **Q.** What type of work and analysis have you undertaken
13 during your career as an economist at CRA?

14 **A.** Well, I've worked on cases in a lot of different areas,
15 a lot of different industries, a lot of different types of
16 matters.

17 I do have quite a bit of experience looking at the
18 pharmaceutical industry. I've looked at matters involving
19 pharmaceutical manufacturing, pharmaceutical distribution,
20 pharmacy benefit management, retail pharmacy. So, I do have
21 experience analyzing large datasets in that type of context.

22 **Q.** Doctor, can you give the Court some examples of the
23 type of data analytics that you've undertaken in the course
24 of your career?

25 **A.** Sure. An example would be for a merger of large

1 national retail chain pharmacies. I was retained by the
2 Federal Trade Commission to assist them in their antitrust
3 evaluation of that transaction. In that context, I analyzed
4 terabytes of prescription data from thousands of pharmacies
5 on thousands of drugs for multiple years. So, that's the
6 type of data analytics I get involved in.

7 **Q.** Doctor, is it common for you to be called upon to
8 review the models or analyses put forward by other experts
9 and economists?

10 **A.** Yes, it is.

11 **Q.** Doctor, during the course of your career, have you
12 published articles in the fields of econometrics and
13 modeling?

14 **A.** Yes, I have.

15 **Q.** And have you also lectured or been asked to give
16 presentations in those same areas?

17 **A.** Yes, I have.

18 **Q.** Based on your expertise in economics and data analysis,
19 have you been asked to serve as an expert in litigation
20 previously?

21 **A.** Yes. Occasionally, yes.

22 **Q.** Have you ever testified at trial in any of those
23 matters?

24 **A.** Yes, once.

25 **Q.** Is your work in the litigation context a significant

1 portion of the work that you do at CRA?

2 **A.** No. Most of my work is not -- not in litigation.

3 **Q.** Thank you, Doctor.

4 MS. WU: Your Honor, I'd tender Dr. Boberg as an
5 expert qualified in econometrics and the analysis of large
6 datasets.

7 THE COURT: Any -- any objection?

8 MR. FARRELL: Judge, may I voir dire the witness?

9 THE COURT: Pardon me?

10 MR. FARRELL: May I voir dire the witness?

11 THE COURT: Yes, you may.

12 **CROSS EXAMINATION**

13 **BY MR. FARRELL:**

14 **Q.** Dr. Boberg, I introduced myself briefly. My name is
15 Paul Farrell. I have a couple of questions for you. Have
16 you ever designed or implemented a Suspicious Order
17 Monitoring System for anybody in the pharmaceutical industry
18 dealing with controlled substances?

19 **A.** I have not.

20 **Q.** Are you familiar with or an expert in the field of
21 tracking pharmaceuticals within the closed chain of
22 distribution?

23 **A.** I'm not an expert on that.

24 **Q.** All right. And I was a little confused, but do you
25 intend to offer opinions on whether the criteria that form

1 the basis of Dr. McCann's algorithms are appropriate?

2 **A.** No. I was asked to look at Dr. McCann's application of
3 the algorithms, not the underlying algorithms.

4 **Q.** That's what I was getting to. You're going to simply
5 take for truth the six methodologies that were just shown to
6 you and advise the Court whether or not those six
7 methodologies were appropriately inputted by Dr. McCann with
8 the data; is that my understanding?

9 **A.** I have been asked to look at how Dr. McCann applied the
10 algorithm. So, I'm looking at his application of the
11 algorithms. And that includes assumptions that he made to
12 implement the algorithms, choices he made along the way, and
13 the results that he obtained as a result of his application.

14 **Q.** Well, your expert report says on Paragraph 62, I offer
15 no opinion on whether the criteria that form the basis for
16 Dr. McCann's algorithms, with or without Dr. McCann's
17 assumption about flagging all reported transactions
18 thereafter, are appropriate for flagging shipments.

19 Are you -- are you intending to testify today that you
20 do have comments upon Dr. McCann's assumptions?

21 **A.** What I'm saying in that paragraph is that I'm not
22 offering an opinion as to whether a particular methodology,
23 if it were used by a distributor, for example, is
24 appropriate or not. That's not something I have expertise
25 on. I'm simply looking at Dr. McCann's application of the

1 algorithm and how he obtained his results in assessing
2 whether that application is reliable.

3 MR. FARRELL: Okay, thank you.

4 THE COURT: Do you object to his -- me finding him
5 as an expert, Mr. Farrell?

6 MR. FARRELL: I don't think so, Judge.

7 THE COURT: The Court finds Dr. Boberg to be a
8 qualified expert witness in the fields of -- I will have to
9 look in my notes here.

10 I can't read my writing, Ms. Wu. You will have to tell
11 me again.

12 MS. WU: Your Honor, we tender Dr. Boberg as an
13 expert witness qualified in the fields of econometrics and
14 the analysis of large datasets.

15 THE COURT: All right. I find Dr. Boberg to be a
16 qualified witness expert in the fields of econometrics, data
17 analysis and large datasets.

18 Did that get it?

19 MS. WU: Yes, Your Honor. Thank you.

20 May we proceed?

21 THE COURT: You may proceed.

22 MS. WU: Thank you.

23 BY MS. WU:

24 Q. Doctor, before we talk about those analyses, Dr.
25 McCann's application of the methodologies that you just

1 discussed, I would like to talk about the dataset that Dr.
2 McCann started with. Did you review Dr. McCann's trial
3 testimony concerning the dataset that he used to complete
4 his work in this case?

5 **A.** Yes, I did.

6 **Q.** What is your understanding of the nature of the dataset
7 that Dr. McCann employed?

8 **A.** Dr. McCann built a dataset that consists of
9 pharmaceutical shipments from distributors to pharmacies in
10 Huntington and Cabell County using ARCOS data, which is data
11 from the DEA, as well as supplements that were data from the
12 defendant distributors, Cardinal, McKesson and ABDC.

13 **Q.** Doctor, do you have an understanding of why Dr. McCann
14 supplemented the ARCOS data with transactional data from the
15 distributor defendants in this case?

16 **A.** Yes. The ARCOS data Dr. McCann has is limited to the
17 time frame 2006 to 2014. So, he uses the distributor data
18 to fill in areas outside of that and, as well, he has some
19 gaps in the ARCOS data. And so, he uses the defendant
20 distributor data to augment or supplement and correct in the
21 cases the ARCOS data.

22 **Q.** Doctor, in connection with your work in this case, did
23 you spend time reviewing Dr. McCann's dataset?

24 **A.** Yes, I did.

25 **Q.** And what did your review of Dr. McCann's dataset

1 involve?

2 **A.** I looked at the underlying code that Dr. McCann
3 provided that he wrote to build his dataset and looked at
4 the data itself.

5 **Q.** Did you review Dr. McCann's dataset for accuracy?

6 **A.** No, I -- I did not review it for accuracy. I was asked
7 to evaluate the reliability of Dr. McCann's application of
8 the algorithms. I wanted to use the same data as Dr.
9 McCann. And so, I just wanted to understand how he put that
10 data together, but I didn't look -- I didn't assess whether
11 the data themselves are reliable.

12 **Q.** Do you have an opinion on whether Dr. McCann's data
13 itself is reliable?

14 **A.** No, I do not.

15 **Q.** So, I'd like to continue with this dataset as assembled
16 by Dr. McCann. Does that dataset include the information
17 for all orders received by the distributor defendants in
18 this case?

19 **A.** No, it does not. So, as I said earlier, it's shipment
20 data, so it does not include all orders.

21 **Q.** Why is it that a dataset which includes shipments only
22 might differ from a dataset that would include all orders?

23 **A.** Well, there are a few reasons that orders might not
24 turn into shipments. So, one is that the distributors may
25 be conducting due diligence and blocking orders, in which

1 case they would not turn into shipments.

2 It could also be the case that orders are received and
3 drugs are unavailable, out of stock, and so, there's no
4 shipment that occurs. Or it could be that orders come in
5 and there's financial issues that -- that prevent the order
6 from turning into a shipment.

7 **Q.** So, there are various reasons that the data for
8 shipments and orders may differ significantly?

9 **A.** Yes, that's correct.

10 **Q.** Doctor, based on your review of evidence in this case,
11 are you aware that the distributor defendants, McKesson,
12 ABDC and Cardinal, in fact, operated regulatory programs
13 that did block orders for prescription opioids?

14 **MR. FARRELL:** Objection, Your Honor. I think this
15 is outside the scope of his expertise and is cumulative with
16 the testimony directly from the defendants. I don't think
17 this witness has been qualified to be offering opinions
18 about the SOMS system McKesson used.

19 **MS. WU:** Your Honor, the witness is providing his
20 input based on review of evidence in order to explain the
21 nature of the dataset that Dr. McCann presented and not to
22 opine on the nature of the programs operated by the
23 defendants.

24 **THE COURT:** Overruled.

25 You may proceed.

1 MS. WU: Okay.

2 BY MS. WU:

3 Q. Doctor, do you need the question again?

4 A. Sure.

5 Q. Okay. Based on the evidence that you reviewed in this
6 case, are you aware that the defendants, ABDC, McKesson and
7 Cardinal, did, in fact, operate programs that blocked
8 certain orders for prescription opioids?

9 A. Yes. I reviewed a file of blocked orders from
10 McKesson, for instance.

11 Q. Are those blocked orders reflected in the McKesson data
12 that you reviewed for purposes of this case reflected in the
13 -- in the shipment data that McCann used, Dr. McCann used,
14 to present his work in this case?

15 A. No. Those blocked orders would be examples of the kind
16 of orders that we talked about that don't end up in the
17 shipment data that Dr. McCann analyzed.

18 Q. Dr. Boberg, in your opinion, why does it matter that
19 Dr. McCann used data which is limited to shipments in order
20 to try to identify suspicious orders?

21 A. Well, it really means he's running --

22 MR. FARRELL: Objection, Your Honor. Again, if
23 this is application to algorithms to data, that's one thing.
24 If this is talking about the legal requirements of
25 identifying suspicious orders, that's something completely

1 different, Judge.

2 MS. WU: Your Honor, the witness is talking about
3 providing testimony as to the appropriateness of the data
4 that Dr. McCann used, not as to the nature of the programs.

5 THE COURT: I think this is an appropriate basis
6 for what I expect his expert opinion to be. I will overrule
7 the objection and let you go ahead.

8 MS. WU: Thank you, Judge.

9 THE WITNESS: So, the dataset that he relies on is
10 not the right dataset to run the algorithms on for purposes
11 of flagging orders because of shipments and if, you know,
12 orders are not in the data, the orders that are not in the
13 data are likely to be the ones that the algorithms would be
14 trying to flag and that's going to make the algorithms flag
15 the wrong shipments.

16 BY MS. WU:

17 **Q.** Thank you, Doctor. So, now I want to turn to some of
18 those methodologies which Mr. Rafalski presented to the
19 Court. As an initial matter, have you reviewed Mr.
20 Rafalski's trial testimony from this case?

21 **A.** Yes, I have.

22 **Q.** And you testified a few moments ago that Mr. Rafalski
23 relied on the work of Dr. McCann in order to run
24 methodologies for flagging purposes, correct?

25 **A.** Yes, that's correct.

1 **Q.** Did you review Dr. McCann's trial testimony about those
2 flagging methodologies?

3 **A.** Yes, I did.

4 **Q.** And did you also review his work papers and deposition
5 in this case?

6 **A.** Yes. Dr. McCann testified in his deposition about --
7 about the methodologies and I reviewed that, as well as his
8 report and backup materials.

9 **Q.** Based on your review of Dr. McCann's work, were you
10 able to understand how Dr. McCann's six flagging
11 methodologies operate?

12 **A.** Yes. I was able to essentially write my own code that
13 replicated what Dr. McCann did based on his descriptions and
14 backup materials. And so, I was able to satisfy myself that
15 I understood Dr. McCann's analysis.

16 MS. WU: Mr. Reynolds, could we put back up on the
17 screen Rafalski Demonstrative 223 at Page 14?

18 BY MS. WU:

19 **Q.** Dr. Boberg, once again, these are the six
20 methodologies, the flagging methodologies that Mr. Rafalski
21 presented to the Court, correct?

22 **A.** Yes, that's correct.

23 **Q.** Based on your review of Mr. Rafalski's trial testimony
24 on this case, in this case, do you have an understanding
25 that Mr. Rafalski believes certain of these flagging

1 methodologies are unreliable?

2 **A.** Yes. I believe Mr. Rafalski testified that he relies
3 on Methods A and B, but views Methods C, D, E and F as
4 unreliable.

5 **Q.** Okay. So, based on Mr. Rafalski's testimony, we'll
6 drop Methods C, D, E and F from our list and we'll focus our
7 work this afternoon on Methods A and B. So, let's do that
8 now.

9 So, Method A, as described by Mr. Rafalski to this
10 Court, is the maximum monthly trailing six-month thresholds.
11 Do you see that, Dr. Boberg?

12 **A.** Yes, I do.

13 **Q.** Okay.

14 MS. WU: Now, to help us talk about this Method A,
15 Mr. Reynolds, could we please put up McKesson Demo 2 at Page
16 1?

17 BY MS. WU:

18 **Q.** Dr. Boberg, is this demonstrative a presentation of how
19 Dr. McCann's Methodology A operates?

20 **A.** Yes, it is.

21 **Q.** Using this demonstrative, could you describe for the
22 Court your understanding of how Dr. McCann's Method A
23 functions to flag orders?

24 **A.** Yes. So, this demonstrative provides sort of a made-up
25 dataset of shipments from a distributor to a pharmacy of a

1 particular drug and the numbers represent dosage units
2 shipped in the month.

3 What Dr. McCann's Method A algorithm does is it looks
4 at the first six months. That's January, February, March,
5 April, May, June and finds the maximum across those six
6 months, which is the 10,000 dosage units shipped in
7 February.

8 It then uses that maximum, the 10,000, as a threshold
9 and tests whether the shipment volume in the seventh month,
10 July, exceeds that threshold or not.

11 In this case, it does not. It's only 4,900. So, July
12 is not flagged.

13 Then the algorithm proceeds to the next month, August,
14 which shows the dosage unit volume of 10,100. That does
15 exceed the threshold from the prior, the maximum from the
16 prior six months, the 10,000. And so, August gets flagged
17 and we've turned that red in the demonstrative.

18 **Q.** Now, from that point on, I see that the balance of the
19 orders in this demonstrative are also flagged red. Are they
20 flagged because Method A flags orders that exceed the
21 threshold or for some other reason?

22 **A.** For other reasons. So, Dr. McCann's algorithm after
23 August would no longer flag, for instance, September because
24 September's volume is only 7,000. So, it's below the
25 threshold, which is the maximum from the prior six months.

1 But Dr. McCann, instead of simply applying the
2 algorithm, he adds this additional assumption that once he
3 flags a shipment from a distributor to a pharmacy of a
4 particular drug, he assumes that every subsequent shipment
5 should also be flagged, viewed as suspicious and unlawful.
6 So, he turns the entire set of shipments red.

7 **Q.** And just for clarity based on some questions you
8 received from Mr. Farrell, is that assumption separate from
9 the underlying algorithm that Dr. McCann utilized for Method
10 A?

11 **A.** Yes. It's a separate assumption, that's correct.

12 **Q.** Dr. Boberg, what would happen to Method A if you
13 removed that automatic flagging assumption as employed by
14 Dr. McCann?

15 **A.** What would happen is you'd no longer flag the vast
16 majority of the shipments. You would only flag those
17 shipments in August.

18 **Q.** And we've now gone to the second page of McKesson
19 Demonstrative 2. How does this second page of the
20 demonstrative illustrate the impact of removing that
21 assumption?

22 **A.** Well, as we've just said, and indicated, and shown on
23 the screen, it's a pretty dramatic effect in this example.
24 We'll see it's a dramatic effect in Dr. McCann's actual
25 results, as well, but it means that he is really excessively

1 flagging shipments by using -- applying this assumption.
2 And when we take the assumption away, Dr. McCann's algorithm
3 flag very few shipments.

4 **Q.** Thank you, Doctor.

5 MS. WU: Mr. Reynolds, we can take down the
6 demonstrative.

7 BY MS. WU:

8 **Q.** Dr. Boberg, based on your review of the record in this
9 case, including testimony from Dr. McCann and Mr. Rafalski,
10 do you have an understanding of why they implemented this
11 automatic flagging assumption?

12 **A.** Well, Dr. McCann really doesn't provide a basis, as far
13 as I understand he was asked to apply the assumption by
14 counsel.

15 Mr. Rafalski says that the assumption is reflective of
16 the idea that there was no due diligence done on the first
17 order and, therefore, every subsequent shipment should be
18 blocked and regarded as suspicious and unlawful.

19 So, I think Dr. McCann provides no basis. Mr. Rafalski
20 explains the assumption.

21 **Q.** Dr. Boberg, based on your review of record evidence in
22 this case, are you aware of any evidence which is contrary
23 to that assumption as employed by Dr. McCann?

24 **A.** Yes. As we were just speaking about a bit ago, I
25 reviewed, for instance, blocked order reports from McKesson

1 that showed due diligence was being done and orders were
2 being blocked. So, that type -- that shows that the
3 assumption that Dr. McCann has made is really not valid.

4 **Q.** Dr. Boberg, in your opinion, does Dr. McCann's decision
5 to automatically flag subsequent orders using this
6 assumption affect the validity and reliability of his Method
7 A?

8 **A.** Yes. As we will see, it really impacts the robustness
9 of the analysis. When we take that assumption away, his
10 results really go away.

11 **Q.** Dr. Boberg, did you prepare some charts in connection
12 with your work in this case and the report that you prepared
13 which help illustrate the power of that assumption in Dr.
14 McCann's work?

15 **A.** Yes, I did.

16 MS. WU: Mr. Reynolds, could we please put up
17 Boberg Demonstrative number 3, please?

18 BY MS. WU:

19 **Q.** Dr. Boberg, are these the charts from your report which
20 set forth your presentation of the automatic flagging
21 methods?

22 **A.** Yes, they are.

23 **Q.** Dr. Boberg, can you use these charts to explain for the
24 Court what is represented on the left-hand side in terms of
25 presentation of Dr. McCann's implementation of Method A with

1 the automatic flagging assumption?

2 **A.** Yes. On the left-hand side I've provided a visual
3 depiction of Dr. McCann's results. So, the -- the picture
4 shows the results of Dr. McCann's Method A applied to ARCOS
5 data shipments from all distributors, or from the three
6 defendant distributors into Huntington and Cabell County,
7 West Virginia.

8 The height of the bars, each bar, represents the
9 monthly shipment volume for that month. And then, I've
10 colored the bar dependent on whether Dr. McCann's algorithm
11 is flagging shipments or not. So, the fraction of the bar
12 that's colored red is the fraction of shipments that Dr.
13 McCann is flagging with his application of the algorithm.
14 And I've colored blue the portion that represents the
15 fraction that he's not flagging.

16 **Q.** Dr. Boberg, what proportion of shipments did Dr. McCann
17 flag as suspicious using his Method A with the automatic
18 flagging assumption turned on?

19 **A.** So, with the assumption he's flagging about 72 percent,
20 71.9 percent of shipments.

21 **Q.** Doctor, is there a way to determine the amount of
22 shipments that were automatically flagged by Dr. McCann
23 based on the automatic flagging assumption, as opposed to
24 the algorithm?

25 **A.** Yes. So, what I was able to do is take Dr. McCann's

1 code and essentially turn off -- you know, there's a line in
2 the code that imposes the assumption and I can turn that
3 piece of code off and re-run his algorithm so that it's the
4 same analysis. I'm just taking out the assumption.

5 **Q.** And did you, in fact, re-run the algorithm for Method A
6 with the automatic flagging assumption turned off?

7 **A.** Yes, I did.

8 **Q.** Are the results of that analysis presented in the
9 right-hand chart on the screen?

10 **A.** Yes, that's correct.

11 **Q.** Dr. Boberg, could you describe for the Court, using
12 your chart, the results of removing the automatic flagging
13 assumption from Dr. McCann's Method A?

14 **A.** Sure. So, on the right-hand side, I provided the
15 visual depiction analysis as on the left but, again,
16 removing that assumption. And you can see that almost all
17 the bars turn blue, or almost entirely blue, and Dr.
18 McCann's analysis, once we turn off that single assumption,
19 flags only 3 percent, about 3 percent, 3.1 percent of
20 shipments.

21 **Q.** Dr. Boberg, based on the work that you've done and
22 these two charts depicting it, are you able to calculate the
23 percentage of shipments flagged by Dr. McCann's Method A
24 that were flagged only due to the automatic flagging
25 assumption?

1 **A.** Yes. That would be 96 percent. So, 96 percent of the
2 red bars on the left are due solely to the assumption for
3 which Dr. McCann provided no basis.

4 **Q.** And just to clarify, that almost 96 percent of
5 shipments flagged by Dr. McCann's Method A were for
6 shipments that did not exceed the thresholds that he had set
7 under Method A, correct?

8 **A.** That's correct.

9 **Q.** Doctor, in your opinion, is Dr. McCann's Method A a
10 valid and reliable approach for flagging suspicious orders?

11 **A.** No. Given the lack of robustness, when you take one
12 assumption away, I would say they're not reliable.

13 **Q.** Thank you, Doctor.

14 MS. WU: Mr. Reynolds, could we put back up on the
15 screen Rafalski Demonstrative 213 at Page 14?

16 BY MS. WU:

17 **Q.** So, all we have left now is Method B. And, Doctor, Mr.
18 Rafalski referred to Method B as the trailing six-month
19 maximum monthly fixed after first triggered threshold. Do
20 you see that, Doctor?

21 **A.** Yes. It's a mouthful. I do see that.

22 **Q.** Sure is. Okay. Doctor, can you describe to the Court
23 how Method B, presented by Mr. Rafalski based on Dr.
24 McCann's underlying work, operates?

25 **A.** Yes. Method B is almost the same as Method A. It

1 starts out the same way, looks at the six -- prior six
2 months to establish the maximum as the threshold, but
3 whereas Method A says once I flag a shipment, I will assume
4 that every subsequent shipment has to be flagged, Method B
5 uses a different assumption. It doesn't make that
6 assumption but, instead, assumes that the threshold needs to
7 be fixed forever.

8 So, once -- once Dr. McCann sees a flag, then he
9 freezes the threshold and uses that same threshold for the
10 rest of -- of the period.

11 **Q.** Dr. Boberg, what is the impact of fixing the threshold
12 under Method B?

13 **A.** It's quite similar to what happens when he uses the
14 assumption in Method A. It essentially ensures that there
15 can be no legitimate increase in volume of shipments into
16 Huntington or Cabell County. It would -- any legitimate
17 increase in shipments would be flagged as unlawful and
18 suspicious by the assumption.

19 **Q.** Dr. Boberg, did you prepare some charts that would help
20 you describe the impact of the fixed threshold on Method B?

21 **A.** Yes, I did.

22 **Q.** Mr. Reynolds, could we please put up Boberg
23 Demonstrative number 4?

24 Doctor, are these the charts that you prepared in order
25 to illustrate the impact of Dr. McCann's fixed threshold

1 assumption on Method B?

2 **A.** Yes, they are.

3 **Q.** Doctor, starting with the left-hand chart, could you
4 describe for the Court the impact of the fixed threshold
5 assumption as run by Dr. McCann?

6 **A.** Yes. The left-hand side presents a visual depiction of
7 the results of Dr. McCann's Method B, again, applied to the
8 ARCOS data for shipments into Huntington and Cabell County.

9 And this time, with the assumption that the threshold
10 should be fixed, Dr. McCann's algorithm is flagging about
11 28 percent of shipments, 27.6 percent.

12 **Q.** So, that's about 28 percent of shipments with that
13 fixed threshold assumption turned on, correct?

14 **A.** That's correct.

15 **Q.** Dr. Boberg, what happens when you apply Method B,
16 re-run the model, removing that fixed threshold assumption?

17 **A.** So, I've shown that on the right-hand side with the
18 chart on the right-hand side and that reduces the flagging
19 to about 3 percent rather than the 28 percent that Dr.
20 McCann flagged.

21 **Q.** Dr. Boberg, are you able to calculate, based on your
22 work in this case as presented by these charts, what
23 percentage of shipments flagged by Dr. McCann's Method B
24 were flagged due to the application of the fixed threshold
25 assumption?

1 **A.** That's about 89 percent. So, 89 percent of the red
2 bars on the left are really due solely to that assumption
3 that the threshold should be fixed.

4 **Q.** So, they were flagged due to the assumption, as opposed
5 to the underlying algorithm associated with Method B,
6 correct?

7 **A.** That's correct.

8 **Q.** Doctor, in your opinion, is Method B with the fixed
9 threshold assumption turned on a valid and reliable method
10 for identifying suspicious orders?

11 **A.** Well, again, just from the perspective of data
12 analysis, when the results of an analysis hinge so
13 critically on an assumption, there's no support for the
14 assumption. That means the results are really not reliable.

15 **Q.** Thank you, Doctor. So, you also flagged that Dr.
16 McCann's results are inconsistent in terms of the results
17 that they've produced and I'd like to turn to that opinion.

18 Have you prepared a demonstrative that would help you
19 explain the inconsistency in the results presented by Dr.
20 McCann's Methods A and B?

21 **A.** Yes, I have.

22 MS. WU: Mr. Reynolds, could we please put up
23 Boberg Demonstrative number 6, please?

24 BY MS. WU:

25 **Q.** Dr. Boberg, is this your demonstrative presenting the

1 difference in results under Dr. McCann's Method A and B with
2 his assumptions turned on?

3 **A.** Yes.

4 **Q.** Can you explain the difference in results presented in
5 these charts?

6 **A.** Yes. So, on the left under Method A with his
7 assumption that every subsequent shipment should be flagged,
8 Dr. McCann flagged about 72 percent of shipments. On the
9 right, using Method B, which is supposedly also flagging the
10 shipments that should be regarded as suspicious and
11 unlawful, Dr. McCann, with his alternative threshold --
12 fixed threshold assumption, is flagging 28 percent of
13 shipments.

14 **Q.** Dr. Boberg, does this inconsistency impact the
15 reliability of Dr. McCann's analyses?

16 **A.** Yes. When -- again, sort of from the perspective of
17 analyzing data, when you have two methods that are supposed
18 to be doing the same thing and they get such dramatically
19 different results, that's a sign of inconsistency.

20 Dr. McCann doesn't do anything to explain why these
21 methods are getting different answers and doesn't provide
22 any guidance or framework for figuring out which of them
23 might be correct, if any, and that, from the perspective of
24 data analytics, says that they're really not reliable.

25 **Q.** Thank you, Doctor.

1 MS. WU: Mr. Reynolds, we can take down the
2 demonstrative.

3 BY MS. WU:

4 Q. Dr. Boberg, at the outset of your testimony, you also
5 offered the opinion that data analysts are supposed to check
6 their results. They're supposed to take the results and
7 check them against real world data; do you recall that?

8 A. Yes, I do.

9 Q. Why is it important for a data analyst to check results
10 against real world information?

11 A. Well, one of the things that often happens when you run
12 data analysis is there's, you know, questions about, you
13 know, you can often get numbers to say a lot of different
14 things depending on how you analyze them and how you present
15 them. And so, it's really important when you look at the
16 results of the data analysis to see if they're corroborated
17 by other types of evidence.

18 So, that might be documentary evidence, or testimony,
19 or scientific studies, or, you know, in this case,
20 information from regulators, but it is important to make
21 sure that the results you're getting are verified or
22 validated by other sources.

23 Q. Is it generally accepted in your field of economics and
24 data analysis to conduct those types of real world data
25 checks?

1 **A.** Yes.

2 **Q.** Based on your review of the record in this case, do you
3 know if Dr. McCann undertook any type of check of his data
4 results against real world information?

5 **A.** No, he did not. He ran the algorithms and reported the
6 results, but he didn't do anything to test them or check
7 their validity or reliability.

8 **Q.** Dr. Boberg, did you, yourself, undertake the exercise
9 of checking Dr. McCann's results against real world
10 information?

11 **A.** Yes.

12 **Q.** What exercise did you undertake?

13 **A.** Well, given the large percentage of shipments that Dr.
14 McCann flagged as suspicious and unlawful, I looked for a
15 source of information that might be informative as to what
16 the actual amount of diversion is out of the controlled
17 channel and I found the DEA does -- you know, has an
18 obligation to estimate that number each year and they made
19 those estimates public in 2018 and in 2019. So, I compared
20 Dr. McCann's flagging of shipments against the DEA's
21 estimate of the actual diversion out of the controlled
22 channel as kind of a check.

23 **Q.** And the data analysis that you've conducted outside of
24 this case and other opioid litigation, is it common for you
25 to look at a government regulator as a source of information

1 to conduct a data check?

2 **A.** Yes. So, for example, we might turn to the CMS, the
3 Center for Medicare/Medicaid Studies, to get data in the
4 case of hospital or pharmaceutical matters that involve
5 Medicare, for example. So, here, I turned to the DEA as the
6 regulator for this particular area.

7 **Q.** Doctor, have you prepared a demonstrative that would
8 help you explain the data check that you conducted comparing
9 Dr. McCann's results to DEA information?

10 **A.** Yes, I did.

11 MS. WU: Mr. Reynolds, could we please put up
12 Boberg Demonstrative number 7?

13 BY MS. WU:

14 **Q.** Dr. Boberg, is this the demonstrative chart, actually,
15 that you prepared in connection with your work in this case?

16 **A.** Yes, it is.

17 **Q.** Could you describe --

18 MR. FARRELL: Objection, Your Honor. I don't
19 think the foundation has been laid for what the DEA said was
20 the percentage of diversion that occurred and if the DEA did
21 say such a thing, it would be hearsay, and I don't believe
22 that the foundation has been laid to establish this opinion.

23 MS. WU: Your Honor, certainly, Dr. Boberg may
24 rely on hearsay evidence. He has been qualified as an
25 expert. I believe that Mr. Farrell's concerns will be

1 addressed as we walk through Dr. McCann's explanation of
2 this chart, if you provide us a little bit of leeway.

3 THE COURT: Yeah. I think this goes to the weight
4 rather than the admissibility of the opinion and the rules
5 are clear that he can rely on the evidence that's not
6 admissible if it forms a legitimate basis for his opinion.

7 Mr. Farrell, do you want to say anything else?

8 MR. FARRELL: I do, Judge. I would like to know
9 what the evidence is he's relying on.

10 THE COURT: Well --

11 MS. WU: Your Honor, we will talk through the
12 actual data source and, also, Mr. Farrell is free to cross
13 examine the witness using his reliance materials.

14 THE COURT: Yes. Overruled.

15 Go ahead, please.

16 MS. WU: Thank you, Your Honor.

17 BY MS. WU:

18 **Q.** Dr. Boberg, how did you identify DEA reporting as a
19 real world check for Dr. McCann's data analysis?

20 **A.** Well, the DEA has the obligation to estimate the
21 diversion out of the controlled channel and it does that
22 each year. So, I looked on the DEA's website and found
23 their estimates of diversion out of the controlled channel.

24 THE COURT: What's wrong with that, Mr. Farrell?

25 MR. FARRELL: Nothing, Your Honor. I'll sit down.

1 THE COURT: You can cross examine him on it, but
2 he's just explaining what he relied on as a basis of his
3 opinion and if you can bring out that it's not a valid basis
4 on cross, then -- then we'll go from there.

5 BY MS. WU:

6 Q. Doctor Boberg, based on your review of the publicly
7 available estimates from DEA, what percentage of hydrocodone
8 and oxycodone did DEA estimate was diverted from the closed
9 system for the year 2018?

10 A. That's about .1 percent.

11 Q. And has the DEA published similar estimates for the
12 year 2019?

13 A. Yes.

14 Q. Now, having laid that foundation for the DEA
15 information that you utilized for your work, could you
16 explain to the Court the data comparison that you conducted
17 comparing Dr. McCann's Method A results from DEA estimates
18 of diversion from the closed system?

19 A. Yes. So, on the left-hand side, I've shown -- provided
20 a visual depiction of the percentage of shipments in effect
21 that the DEA says were diverted. So, this is -- I calculate
22 this as the DEA's estimate of diversion out of the
23 controlled channel divided by total shipments in the U. S.
24 and that gives me a percentage.

25 And across the various opioids and, as we said for oxy

1 and hydro, that percentage is about .1 percent. It's less
2 than a quarter of a percent across all the drugs that I had
3 data for.

4 On the right-hand side, I've compared that with the
5 results of Dr. McCann's application of the Method A
6 algorithm to shipments into Cabell County and Huntington,
7 West Virginia, where he's flagging 72 percent of shipments
8 as unlawful and suspicious and likely connected to diversion
9 out of the controlled channel.

10 **Q.** Dr. Boberg, from your perspective as a data analyst,
11 how are DEA's estimates relevant to your evaluation of Dr.
12 McCann's analysis?

13 **A.** Well, if Dr. McCann is flagging such a large share of
14 shipments, one would expect that the DEA would be estimating
15 a fairly large amount of diversion out of the controlled
16 channel. That's not what I see.

17 So, I find that Dr. McCann is flagging far in excess of
18 any number that would be consistent with the estimates of
19 actual diversion out of the controlled channel by the DEA.

20 **Q.** Thank you, Doctor.

21 MS. WU: Mr. Reynolds, we can take down the
22 demonstrative.

23 BY MS. WU:

24 **Q.** Now, I would like to turn to the last area that you had
25 introduced to the Court, which is McKesson's market share.

1 You testified earlier that you were asked to analyze
2 McKesson's market share as it relates to the distribution of
3 prescription opioids in Cabell County, correct?

4 **A.** Yes, that's correct.

5 **Q.** What materials do you rely on in order to conduct that
6 analysis?

7 **A.** I relied on the ARCOS data as prepared by Dr. McCann.

8 **Q.** And so, that's the ARCOS data as supplemented with
9 transactional data from McKesson, correct?

10 **A.** That's correct.

11 **Q.** Doctor, have you prepared a demonstrative to assist you
12 in explaining your analysis of McKesson's market share to
13 the Court?

14 **A.** I have.

15 MS. WU: Mr. Reynolds, could we please put up
16 Boberg Demonstrative number 9? Thank you.

17 BY MS. WU:

18 **Q.** Doctor, is this the demonstrative that you prepared to
19 assist with the presentation of your analysis of McKesson's
20 market share?

21 **A.** Yes, it is.

22 **Q.** Dr. Boberg, are you aware that McKesson ships
23 prescription opioids to the VA Medical Center in Huntington,
24 West Virginia?

25 **A.** Yes, I am.

1 **Q.** Based on your review of Dr. McCann's flagging
2 methodologies in this case, are you aware of whether or not
3 Dr. McCann applied those flagging methodologies to shipments
4 of prescription opioids that McKesson made to the VA
5 Hospital?

6 **A.** No. Dr. McCann applied his algorithms to shipments to
7 chain and independent pharmacies only. He did not include
8 the VA Hospital.

9 **Q.** Doctor, did you undertake to calculate the percentage
10 of McKesson's distribution of oxycodone and hydrocodone to
11 Cabell County for the years 2006 to 2014 that went to the VA
12 Medical Center?

13 **A.** Yes.

14 **Q.** And what percentage did you calculate?

15 **A.** That's up on the chart. It's 76, about 76 percent,
16 76.1.

17 **Q.** Dr. Boberg, were you able to determine what Dr.
18 McCann's market share in Huntington and Cabell County would
19 be as compared to other distributors if you removed the VA
20 from McKesson's shipments of hydrocodone and oxycodone?

21 **A.** Yes.

22 **Q.** What percentage did you calculate?

23 **A.** I calculated about 6 percent. And that's the same
24 number that Dr. McCann calculates using the same data.

25 MS. WU: Thank you, Doctor. I have no further

1 questions at this time.

2 THE COURT: All right. Let's take a break here
3 and then we'll come back and subject you to cross
4 examination, Dr. Boberg.

5 THE WITNESS: Thank you.

6 (Recess taken)

7 (Proceedings resumed at 3:27 p.m. as follows:)

8 THE COURT: You can resume the witness stand,
9 sir.

10 Go ahead, Mr. Farrell.

11 CROSS EXAMINATION

12 BY MR. FARRELL:

13 Q. Good afternoon. I'm Paul Farrell. We met off the
14 record. I have a few questions for you.

15 MR. FARRELL: Can we bring up the first slide with
16 the methodologies?

17 Judge, may I?

18 THE COURT: Yes, please.

19 BY MR. FARRELL:

20 Q. Dr. Boberg, you understand that these six
21 methodologies were presented to this Court through
22 former DEA Agent James Rafalski?

23 A. Yes.

24 Q. And you understand that Methodology A came from a
25 literal interpretation of the *Masters vs. Pharmaceutical*

1 case published by the Circuit Court in the District of
2 Columbia?

3 **A.** I, I'm not familiar with --

4 **Q.** You weren't aware of that?

5 **A.** I'm generally familiar with the connections of the -- a
6 connection being drawn to *Masters* but, you know, I'm not an
7 expert on *Masters*.

8 **Q.** And you understand that Mr. Rafalski was actually the
9 investigator from the DEA on the *Masters* case?

10 **A.** I understand that from his, his trial transcript.

11 **Q.** And then subsequent to that, you understand that B
12 comes from using not the *Masters* language from the Circuit
13 Court of the District of Columbia. B is actually using the
14 policy manual from *Masters Pharmaceutical*.

15 Did you understand that?

16 **A.** Well, let me just clarify. I mean, Method A and Method
17 B, as Dr. McCann applies them, has these assumptions in
18 them. And as I understand it, those are not part of *Masters*
19 or, or other sources.

20 **Q.** That's not my question. My question is do you
21 understand that the testimony from this case from Mr.
22 Rafalski was that A and B come from *Masters Pharmaceutical*
23 distributor?

24 **A.** A and B, as Dr. McCann ran them or, I mean -- as he ran
25 them, no, because Dr. McCann runs them on shipment data

1 rather than orders. And he's invoking assumptions that, as
2 I understand it, are not part of the methodology.

3 **Q.** Okay. Sir, you understand that the DEA has testified
4 in this case through their 30(b)(6) witness on what to do
5 with all future orders? Do you understand that's in the
6 record?

7 MS. WU: Your Honor, objection, foundation. This
8 isn't the proper witness to cross with DEA testimony he's
9 never reviewed.

10 THE COURT: Well, this is cross-examination. Go
11 ahead, Mr. Farrell. I think wide latitude should be
12 permitted here. Go ahead.

13 BY MR. FARRELL:

14 **Q.** Were you aware that the DEA itself has validated
15 the concept of once you block a suspicious order, you
16 should block all future shipments until cleared?

17 **A.** That's not something I'm aware of from reviewing
18 testimony.

19 THE COURT: Mr. Mahady.

20 MR. MAHADY: Your Honor, I would just note that we
21 do object on foundation grounds to that question and
22 statement. And I think Mr. Prevoznik's deposition testimony
23 and what's been designated by both sides speaks for itself.
24 But that's just for the record.

25 THE COURT: Well, overruled.

1 Go ahead, Mr. Farrell.

2 BY MR. FARRELL:

3 **Q.** Let me put it in a different context. You
4 understand that some of the defendants themselves, like
5 AmerisourceBergen, had policies in effect that said that
6 once an order is blocked, all future shipments of the
7 same base code should also be blocked until cleared of
8 due diligence?

9 **A.** So, again, that -- what I was asked to look at is Dr.
10 McCann's application of these algorithms, so I'm not
11 familiar with what the defendant distributors' policies
12 were.

13 **Q.** And you understand that Methodology E comes directly
14 from McKesson, the distributor that hired you in this case?

15 **A.** I, I don't think that's -- I don't think that's a
16 correct way to say that. No, I don't agree.

17 **Q.** Well, let me say it in a different way. Have you read
18 the deposition of Nate Hartle who is the 30(b)(6) deponent
19 for McKesson?

20 **A.** I have not.

21 **Q.** Okay. Are you aware that he testified about this 8,000
22 dosage unit limit rule? It's in his testimony.

23 **A.** Again, as -- what I look at is Dr. McCann's application
24 of these algorithms. So I did not review that testimony.

25 **Q.** Sir, I'm asking you whether or not you have looked at

1 the deposition of Nate Hartle and understand that
2 Methodology E is McKesson's methodology.

3 **A.** I have not reviewed the testimony.

4 **Q.** Have you applied Methodology E to the data?

5 MS. WU: Your Honor, foundation. I don't believe
6 that Mr. Farrell has a good faith basis to continue this
7 line of questioning when the witness has said that he has
8 not reviewed these materials.

9 MR. FARRELL: Judge, my good faith basis -- I'm
10 sorry.

11 THE COURT: Well, the fact that he hasn't reviewed
12 them is part of the point you're making, isn't it?

13 MR. FARRELL: Yes.

14 THE COURT: Okay. Overruled. Go ahead.

15 BY MR. FARRELL:

16 **Q.** In fact, have you actually tried to apply
17 McKesson's own algorithm to McKesson's data to see how
18 many orders should have been flagged?

19 **A.** That's not what I was asked to do. No, I have not. I
20 looked at Dr. McCann's application of the algorithms, not
21 McKesson's programs.

22 **Q.** In the materials that you've reviewed, have you seen
23 anywhere where McKesson has actually run their algorithm on
24 their retrospective data to try to figure out what should
25 have been flagged?

1 **A.** Again, I focused on Dr. McCann's application of these
2 algorithms. I have not looked at how the distributors were
3 running the programs.

4 **Q.** This is what has been affectionately referred to by me
5 alone as the matrix. And it has pharmacies in
6 Huntington/Cabell County, West Virginia.

7 Have you attempted to run any algorithm on the actual
8 data from the pharmacies in Huntington/Cabell County, West
9 Virginia?

10 **A.** I'm trying to process your question.

11 First of all, I have never seen that before, so I don't
12 know what you're referring to. But what I've done is
13 replicated Dr. McCann's application of these algorithms on
14 ARCOS data, as well as the defendant distributor data.

15 To the extent that pharmacy shipments to a specific
16 pharmacy you're referring to are in those data, then I have
17 run Dr. McCann's application of the algorithms on those --
18 on shipments to those pharmacies.

19 MR. FARRELL: Go to the next slide, please. I'm
20 sorry. From the defendants, the one with all of the months
21 and the seats. It's like an arena. There we go.

22 BY MR. FARRELL:

23 **Q.** So do you recall talking about this, this
24 particular slide? You understand how it's supposed to
25 run, do you not?

1 **A.** There were two questions there. I do recall referring
2 to this slide, yes.

3 **Q.** So, basically, the idea under the *Masters* methodology
4 is you take a look at a period of time and you try to find
5 an average; correct?

6 **A.** So, no. Dr. McCann's algorithm, what it does is looks
7 at the maximum across the last six months, not the average.

8 **Q.** We'll use that. What's the maximum here for the last
9 six weeks or six months in this, in this example?

10 **A.** As I said earlier, it's 10,000 from February, 10,000
11 dosage units from February.

12 **Q.** And, so, if there are sales in excess of 10,000, it's
13 supposed to trigger something. Agreed?

14 **A.** Just to be clear, the way the algorithm works is if the
15 cumulative shipment volume within a month exceeds the
16 maximum monthly shipments from any of the prior six months,
17 then that shipment is flagged and shipments for the
18 remaining, remainder of the month are flagged.

19 **Q.** Perfect. So once you reach some threshold, it's
20 supposed to be flagged. Agreed?

21 **A.** That's what the algorithm does, yes.

22 **Q.** Okay. So what's supposed to happen after the flag?

23 **A.** The algorithm moves to the next month and evaluates the
24 shipments of that month against the prior six months.
25 That's what the algorithm does.

1 **Q.** I see. I see. What do the policies of McKesson say
2 should be done after the flag?

3 **A.** Dr. McCann didn't review the policies --

4 **Q.** I'm not asking you that. What do the policies of
5 McKesson say should be done after the flag?

6 **A.** That's not something I reviewed.

7 **Q.** Let me give you an example. Let's go to the very next
8 one. The very next one is the one that, where you say this
9 is what it should look like using this theoretical
10 distribution month by month. Do you see this?

11 **A.** I see the chart.

12 **Q.** Okay. Have you made an attempt to run that same, same
13 analysis to a pharmacy, say, in Logan County, West Virginia,
14 that's averaging 180,000 pills a month?

15 **A.** Again, all I can say is to the extent that the
16 pharmacies you're referring to are in Dr. McCann's data,
17 then Dr. McCann has run his algorithm on those shipments.
18 And I have also run Dr. McCann's algorithm on those
19 shipments.

20 **Q.** Sir, let me ask you in a different way. If let's say
21 in a small town of 400 people McKesson is selling 100,000
22 prescription opioids a month and an algorithm flags it and
23 says something's going on here. Should McKesson still be
24 able to ship 100,000 every month thereafter? Is that your
25 opinion?

1 **A.** I don't have an opinion about that. That's not
2 something that I have expertise on.

3 **Q.** Your testimony was that the DEA estimates that
4 .1 percent of prescription opioids are being diverted. Are
5 you taking that information from the congressional testimony
6 that 99.99 percent of doctors are trying to do the good
7 thing? Is that where you're getting that data from?

8 **A.** No.

9 **Q.** Where are you getting that from?

10 **A.** As I testified, and as I specified in my report, I went
11 to the DEA's website where they publish their estimates of
12 diversion out of the controlled channel of a number of
13 drugs, and they publish that in kilograms.

14 And I took their estimate of diversion out of the
15 controlled channel and I divided by total shipments to come
16 up with an estimate of what fraction of shipments are then
17 diverted out of the controlled channel.

18 **Q.** Where does the DEA get this from?

19 **A.** That's something that the DEA does. I don't have --
20 I'm not an expert on how the DEA estimates its diversion out
21 of the controlled channel. But that's one of the things
22 that it's obligated to do and one of the things that it does
23 each year.

24 **Q.** You understand that there have been no less than 15 DEA
25 agents who have been deposed in this case and that's -- what

1 you've just said is nowhere in the record?

2 **A.** Is that a question?

3 **Q.** Yes. Do you understand that that is nowhere in the
4 record in this case?

5 **A.** I have not reviewed the entire record of this case, so
6 I wouldn't know that.

7 **Q.** So let me just take one particular example and see if
8 we can get there. And I'm going to take the most ridiculous
9 of examples as I can.

10 Do you know where Mingo County, West Virginia, is?

11 **A.** I do not.

12 **Q.** In Mingo County, West Virginia, let's just --

13 THE COURT: Just a minute, Mr. Farrell.

14 Ms. Wu.

15 MS. WU: Your Honor, just for the record, we
16 object based on geographic scope. And if we're going to
17 continue, I'd ask for a running objection. But I don't
18 think this is appropriate or relevant.

19 THE COURT: Well, I'll let him -- he's using it as
20 an example. I'll let him go ahead and do it.

21 BY MR. FARRELL:

22 **Q.** In Mingo County, West Virginia, if 268,000 doses of
23 hydrocodone are sold in one month to one pharmacy, is it
24 your testimony that only .1 percent of those are being
25 diverted?

1 **A.** No. My testimony is that the DEA estimates that, that
2 the level of diversion out of the controlled channel of
3 oxycodone, hydrocodone in 2018 and '19 is consistent with
4 about .1 percent of shipment volumes being diverted out of
5 the controlled channel.

6 **Q.** Last question, Doctor. This is an exhibit in this case
7 and it demonstrates a volume of pills that were sold into
8 the geographic region of Huntington/Cabell County, West
9 Virginia.

10 Based on your knowledge of algorithms to detect
11 suspicious orders, would you expect that any of these
12 orders, any of these shipments to be suspicious?

13 **A.** Well, it's zip code 255 and 257 which is not the same
14 as Huntington and Cabell County.

15 **Q.** Let's just ignore anything but the pattern. Is there
16 anything suspicious about this pattern of the sale of
17 prescription opioids?

18 **A.** How do you want me to interpret the word "suspicious"
19 there?

20 **Q.** Well, you've testified today -- you're here today
21 talking about algorithms to detect suspicious orders. So
22 we'll use whatever, whatever measure you want to use. Let's
23 just use the broader one, "suspicious." Is there anything
24 suspicious about this demonstrative?

25 **A.** Well, the only context I have for suspicious in this

1 case is Dr. McCann's use of the word "suspicious" to
2 characterize the results of his application of algorithms to
3 the ARCOS data of shipments into Huntington and Cabell
4 County, West Virginia.

5 **Q.** All right.

6 **A.** So I have not run his, his algorithms on those data,
7 but I have run them on, on shipments into Cabell County and
8 Huntington, West Virginia.

9 **Q.** If this is the sale of beer in Huntington, Cabell
10 County, West Virginia, is there anything suspicious about
11 this pattern?

12 **A.** I don't think I can answer the question. I don't have
13 a definition of "suspicious" with respect to beer shipments.

14 **Q.** If this was machine guns sold into West Virginia, is
15 there anything suspicious about this pattern?

16 **A.** Again, same thing. Suspicious as defined by Dr. McCann
17 relates back to the, the Suspicious Order Monitoring
18 Programs and his use of the algorithms applied to ARCOS
19 data. So that's the context in which I think I, I would use
20 the term "suspicious" here.

21 **Q.** Let me try one last time. If this is the number of
22 home runs that were hit in a major league baseball season
23 and you looked at this over time, would you find anything
24 suspicious about this pattern?

25 **A.** Again, same thing. This is -- you know, the purpose of

1 talking about suspicious to me is -- relates back to Dr.
2 McCann. He's the one who uses the word "suspicious." I'm
3 simply looking at Dr. McCann's application of algorithms
4 where he's flagging 72 percent of shipments as suspicious
5 and unlawful and assessing whether that makes any sense.

6 MR. FARRELL: Thank you. No further questions,
7 Judge.

8 THE COURT: Any redirect, Ms. Wu?

9 MS. WU: Nothing further. Thank you.

10 THE COURT: May Dr. Boberg be excused?

11 MR. FARRELL: Yes, Your Honor.

12 THE COURT: Thank you, Dr. Boberg. You're free to
13 go. Thank you, sir, very much.

14 THE WITNESS: Thank you very much, Your Honor.

15 MS. MAINIGI: So, Your Honor, I think that's the
16 extent of our witnesses for today. As I mentioned, we have
17 a Cardinal witness similar to the prior two witnesses. He
18 had a -- he had prior testimony scheduled for today. So we
19 can put him on first thing in the morning.

20 THE COURT: Will he be here first thing in the
21 morning?

22 MS. MAINIGI: He will be here first thing in the
23 morning. He's actually here. He's doing that testimony by
24 Zoom right now. So he's, he's in town.

25 THE COURT: I'm sorry. I interrupted you. You go

1 ahead.

2 MS. MAINIGI: And that will be our only witness
3 tomorrow. So just in terms of the amount of time that would
4 take, probably somewhat comparable.

5 THE COURT: Okay. Well, we'll start at 9:00 in
6 the morning.

7 Is there anything else to do today before we adjourn?

8 (No Response)

9 THE COURT: Hearing none, I'll see everybody at
10 9:00.

11 MS. MAINIGI: Thank you.

12 (Trial recessed at 3:46 p.m.)
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1 CERTIFICATION:

2 I, Ayme A. Cochran, Official Court
3 Reporter, and I, Lisa A. Cook, Official Court Reporter,
4 certify that the foregoing is a correct transcript from
5 the record of proceedings in the matter of The City of
6 Huntington, et al., Plaintiffs vs. AmerisourceBergen
7 Drug Corporation, et al., Defendants, Civil Action No.
8 3:17-cv-01362 and Civil Action No. 3:17-cv-01665, as
9 reported on July 8, 2021.

10
11 S\Ayme A. Cochran

12 Reporter

13 s\Lisa A. Cook

14 Reporter

15 —

16 July 8, 202117 Date
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	180,000 [1] - 194:14 19 [2] - 101:11 19087 [1] - 6:15 19103 [2] - 6:6, 6:13 1978 [1] - 25:15 1981 [2] - 25:21, 56:9 1983 [1] - 56:16 1986 [1] - 56:12 1987 [2] - 26:10, 26:18 1990 [1] - 26:25 1995-96 [1] - 73:20 1997 [1] - 88:7 1998 [1] - 28:2 1999 [1] - 94:20	2014 [13] - 37:6, 38:25, 39:4, 44:8, 46:8, 47:6, 49:5, 49:12, 50:1, 50:13, 52:25, 161:17, 186:11 2015 [9] - 81:15, 109:21, 110:2, 110:10, 112:22, 113:8, 113:11, 114:1, 114:11 2016 [1] - 7:21 2017 [2] - 7:21, 73:20 2018 [6] - 95:6, 138:7, 138:8, 180:19, 183:9, 197:3 2019 [4] - 28:14, 28:18, 180:19, 183:12 202 [2] - 2:4, 2:13 2020 [1] - 54:21 2021 [4] - 1:19, 7:4, 201:9, 201:15 20s [1] - 97:25 21 [1] - 156:8 213 [1] - 174:15 2216 [1] - 3:7 223 [2] - 152:2, 166:17 25 [5] - 5:5, 8:9, 11:10, 11:12, 33:10 25.3 [1] - 91:9 25301 [3] - 2:8, 3:13, 4:24 25322 [1] - 6:9 25338-3843 [1] - 5:15 255 [1] - 197:13 256 [1] - 89:10 257 [1] - 197:13 25701 [1] - 3:10 26 [3] - 131:13, 137:15, 137:21 268,000 [1] - 196:22 27.6 [1] - 176:11 2768 [2] - 52:20, 52:23 2769 [2] - 46:1, 46:2 28 [8] - 4:3, 4:12, 4:14, 154:8, 176:11, 176:12, 176:19, 178:12 29464 [3] - 4:4, 4:12, 4:15 2:00 [2] - 131:2	3.1 [1] - 173:19 30 [7] - 8:21, 33:18, 93:8, 95:13, 95:15, 125:9, 136:9 30(b)(6) [2] - 189:4, 190:18 31.6 [1] - 91:8 3100 [2] - 6:5, 6:12 316 [1] - 2:11 32502 [1] - 2:11 33 [7] - 78:16, 78:18, 78:19, 81:3, 82:14 34 [1] - 82:14 35 [1] - 82:10 36 [3] - 1:16, 82:23, 82:24 3843 [1] - 5:14 3:17-cv-01362 [2] - 1:5, 201:8 3:17-cv-01665 [2] - 1:11, 201:8 3:27 [1] - 187:7 3:46 [1] - 200:12	6 6 [5] - 91:12, 101:9, 139:11, 177:23, 186:23 6,000 [1] - 33:10 60 [2] - 28:12, 95:1 600 [1] - 2:10 62 [1] - 159:14 6:00 [1] - 130:23 6th [1] - 3:5
0 0 [1] - 88:20 006 [1] - 88:20 00907 [2] - 2:5, 2:14 01 [1] - 105:6 0169 [1] - 89:14 02 [1] - 89:9 02768 [2] - 44:4, 47:20 02769 [1] - 47:19	2 2 [2] - 167:15, 169:19 20 [4] - 8:8, 8:9, 30:24, 62:7 2000 [1] - 87:16 20001 [1] - 5:12 20004 [2] - 4:7, 4:10 20005 [3] - 4:19, 4:21, 5:5 2001 [3] - 91:5, 92:25, 141:1 2002 [1] - 141:1 2006 [16] - 37:6, 38:25, 39:4, 44:8, 46:8, 46:15, 46:19, 46:25, 47:6, 49:4, 49:11, 50:1, 50:13, 52:25, 161:17, 186:11 2009 [1] - 45:21 2010 [32] - 75:6, 77:14, 77:22, 81:15, 81:17, 83:1, 84:6, 84:7, 84:11, 84:13, 85:8, 85:10, 85:21, 88:7, 90:15, 90:17, 91:5, 93:1, 93:2, 94:21, 95:6, 97:14, 97:20, 97:22, 98:3, 99:6, 101:1, 101:2, 101:5, 101:8, 102:11, 138:7 2010-11 [2] - 73:20, 85:4 2011 [11] - 79:10, 80:6, 80:7, 80:18, 82:19, 82:20, 109:21, 110:10, 112:22, 114:1, 114:11 2011-2012 [1] - 73:10 2012 [5] - 28:11, 28:13, 28:14, 28:17, 82:22 2013 [5] - 81:17, 81:18, 83:1, 83:2, 138:8	2019 [4] - 28:14, 28:18, 180:19, 183:12 202 [2] - 2:4, 2:13 2020 [1] - 54:21 2021 [4] - 1:19, 7:4, 201:9, 201:15 20s [1] - 97:25 21 [1] - 156:8 213 [1] - 174:15 2216 [1] - 3:7 223 [2] - 152:2, 166:17 25 [5] - 5:5, 8:9, 11:10, 11:12, 33:10 25.3 [1] - 91:9 25301 [3] - 2:8, 3:13, 4:24 25322 [1] - 6:9 25338-3843 [1] - 5:15 255 [1] - 197:13 256 [1] - 89:10 257 [1] - 197:13 25701 [1] - 3:10 26 [3] - 131:13, 137:15, 137:21 268,000 [1] - 196:22 27.6 [1] - 176:11 2768 [2] - 52:20, 52:23 2769 [2] - 46:1, 46:2 28 [8] - 4:3, 4:12, 4:14, 154:8, 176:11, 176:12, 176:19, 178:12 29464 [3] - 4:4, 4:12, 4:15 2:00 [2] - 131:2	3.1 [1] - 173:19 30 [7] - 8:21, 33:18, 93:8, 95:13, 95:15, 125:9, 136:9 30(b)(6) [2] - 189:4, 190:18 31.6 [1] - 91:8 3100 [2] - 6:5, 6:12 316 [1] - 2:11 32502 [1] - 2:11 33 [7] - 78:16, 78:18, 78:19, 81:3, 82:14 34 [1] - 82:14 35 [1] - 82:10 36 [3] - 1:16, 82:23, 82:24 3843 [1] - 5:14 3:17-cv-01362 [2] - 1:5, 201:8 3:17-cv-01665 [2] - 1:11, 201:8 3:27 [1] - 187:7 3:46 [1] - 200:12	7 7 [3] - 97:20, 97:25, 181:12 7,000 [1] - 168:24 70130 [1] - 3:8 707 [1] - 4:24 71.9 [1] - 172:20 716 [1] - 3:12 72 [5] - 154:7, 172:19, 178:8, 184:7, 199:4 725 [2] - 4:19, 4:21 76 [2] - 186:15 76.1 [1] - 186:16
1 1 [11] - 105:6, 121:11, 121:16, 131:7, 155:1, 167:16, 183:10, 184:1, 195:4, 196:24, 197:4 1.6 [1] - 89:14 10 [7] - 8:11, 55:11, 62:7, 109:4, 121:12, 121:13 10,000 [7] - 105:7, 168:6, 168:8, 168:16, 193:10, 193:12 10,100 [1] - 168:14 100,000 [4] - 74:21, 78:22, 194:21, 194:24 1001 [2] - 4:6, 4:9 1006 [2] - 47:15, 50:25 1022 [1] - 3:5 10:03 [1] - 55:12 125 [1] - 29:16 126 [1] - 3:5 13 [3] - 89:7, 89:13, 101:10 1300 [1] - 6:15 1311 [2] - 2:4, 2:14 14 [7] - 44:22, 45:8, 49:8, 83:7, 152:2, 166:17, 174:15 15 [3] - 8:11, 93:8, 195:24 15.69 [1] - 50:5 150 [1] - 29:17 15910 [1] - 3:15 16 [4] - 88:19, 89:1, 89:7, 89:8 1600 [1] - 3:15 1717 [2] - 6:6, 6:13	2 2 [2] - 167:15, 169:19 20 [4] - 8:8, 8:9, 30:24, 62:7 2000 [1] - 87:16 20001 [1] - 5:12 20004 [2] - 4:7, 4:10 20005 [3] - 4:19, 4:21, 5:5 2001 [3] - 91:5, 92:25, 141:1 2002 [1] - 141:1 2006 [16] - 37:6, 38:25, 39:4, 44:8, 46:8, 46:15, 46:19, 46:25, 47:6, 49:4, 49:11, 50:1, 50:13, 52:25, 161:17, 186:11 2009 [1] - 45:21 2010 [32] - 75:6, 77:14, 77:22, 81:15, 81:17, 83:1, 84:6, 84:7, 84:11, 84:13, 85:8, 85:10, 85:21, 88:7, 90:15, 90:17, 91:5, 93:1, 93:2, 94:21, 95:6, 97:14, 97:20, 97:22, 98:3, 99:6, 101:1, 101:2, 101:5, 101:8, 102:11, 138:7 2010-11 [2] - 73:20, 85:4 2011 [11] - 79:10, 80:6, 80:7, 80:18, 82:19, 82:20, 109:21, 110:10, 112:22, 114:1, 114:11 2011-2012 [1] - 73:10 2012 [5] - 28:11, 28:13, 28:14, 28:17, 82:22 2013 [5] - 81:17, 81:18, 83:1, 83:2, 138:8	2019 [4] - 28:14, 28:18, 180:19, 183:12 202 [2] - 2:4, 2:13 2020 [1] - 54:21 2021 [4] - 1:19, 7:4, 201:9, 201:15 20s [1] - 97:25 21 [1] - 156:8 213 [1] - 174:15 2216 [1] - 3:7 223 [2] - 152:2, 166:17 25 [5] - 5:5, 8:9, 11:10, 11:12, 33:10 25.3 [1] - 91:9 25301 [3] - 2:8, 3:13, 4:24 25322 [1] - 6:9 25338-3843 [1] - 5:15 255 [1] - 197:13 256 [1] - 89:10 257 [1] - 197:13 25701 [1] - 3:10 26 [3] - 131:13, 137:15, 137:21 268,000 [1] - 196:22 27.6 [1] - 176:11 2768 [2] - 52:20, 52:23 2769 [2] - 46:1, 46:2 28 [8] - 4:3, 4:12, 4:14, 154:8, 176:11, 176:12, 176:19, 178:12 29464 [3] - 4:4, 4:12, 4:15 2:00 [2] - 131:2	3.1 [1] - 173:19 30 [7] - 8:21, 33:18, 93:8, 95:13, 95:15, 125:9, 136:9 30(b)(6) [2] - 189:4, 190:18 31.6 [1] - 91:8 3100 [2] - 6:5, 6:12 316 [1] - 2:11 32502 [1] - 2:11 33 [7] - 78:16, 78:18, 78:19, 81:3, 82:14 34 [1] - 82:14 35 [1] - 82:10 36 [3] - 1:16, 82:23, 82:24 3843 [1] - 5:14 3:17-cv-01362 [2] - 1:5, 201:8 3:17-cv-01665 [2] - 1:11, 201:8 3:27 [1] - 187:7 3:46 [1] - 200:12	8 8 [6] - 1:19, 7:4, 97:20, 97:25, 201:9, 201:15 8,000 [1] - 190:21 80 [3] - 20:22, 21:11, 58:25 801 [1] - 3:10 80s [1] - 61:5 81 [3] - 13:5, 13:21, 23:10 8252 [3] - 111:17, 114:15, 115:14 84.31 [2] - 50:5, 50:8 850 [1] - 5:12 86 [2] - 21:21, 22:13 89 [2] - 177:1
	3 3 [13] - 91:11, 101:7, 109:24, 111:7, 111:14, 113:19, 115:11, 171:17, 173:19, 176:19 3-times [1] - 114:13	4 4 [1] - 175:23 4,900 [1] - 168:11 4.6 [9] - 111:6, 111:13, 113:18, 113:22, 114:8, 114:12, 115:6, 115:8, 115:11 40 [8] - 8:21, 60:9, 60:10, 61:5, 83:14, 95:1, 95:24, 125:10 400 [1] - 194:21 401 [2] - 4:6, 4:9 405 [1] - 2:7 42 [1] - 98:22 44 [1] - 91:2 47 [1] - 94:6 49 [4] - 53:10, 53:12, 53:16, 88:2	5 5 [1] - 138:2 5.76 [1] - 46:24 50 [4] - 83:7, 94:17, 94:18, 94:25 50-year-olds [1] - 94:25 51 [2] - 91:7, 91:8 5496 [5] - 111:18, 114:17, 114:22, 115:8, 115:13 553 [1] - 6:8 56 [1] - 3:4 56th [1] - 3:5 57 [1] - 91:14	9 9 [1] - 185:16 9/11 [1] - 34:11 90,000 [1] - 23:13 901 [1] - 4:23 91436 [1] - 3:16 94.24 [1] - 47:3 96 [3] - 174:1, 174:4 97 [1] - 89:12 99.99 [1] - 195:6 9:00 [3] - 7:4, 200:5, 200:10 9th [1] - 4:6

<p>A</p> <p>a.m [2] - 7:4, 55:12</p> <p>ABDC [3] - 161:12, 163:12, 164:6</p> <p>able [17] - 10:4, 20:8, 42:25, 54:7, 57:16, 64:21, 65:2, 130:5, 143:18, 166:10, 166:12, 166:14, 172:25, 173:22, 176:21, 186:17, 194:24</p> <p>absence [1] - 119:19</p> <p>absent [1] - 120:2</p> <p>absolutely [1] - 120:20</p> <p>absolves [1] - 16:20</p> <p>abuse [12] - 18:2, 94:5, 125:21, 141:16, 144:13, 144:14, 144:23, 144:24, 144:25, 147:11, 147:12</p> <p>abused [5] - 135:11, 144:15, 144:17, 144:18, 145:6</p> <p>abusing [6] - 86:1, 93:18, 93:24, 136:4, 145:6, 145:7</p> <p>academic [6] - 18:21, 19:23, 58:20, 60:19, 134:9, 134:13</p> <p>academies [1] - 60:19</p> <p>Academy [1] - 60:20</p> <p>accelerates [1] - 75:10</p> <p>acceleration [1] - 134:1</p> <p>accepted [3] - 32:22, 80:20, 179:23</p> <p>access [10] - 12:10, 12:20, 12:22, 13:2, 13:20, 14:1, 14:3, 16:20, 20:5, 123:11</p> <p>account [5] - 91:21, 129:10, 129:13, 143:4, 145:4</p> <p>accountant [4] - 25:17, 25:20, 27:12, 27:17</p> <p>accounted [2] - 91:7, 91:10</p> <p>accounting [12] - 25:9, 27:1, 27:3, 27:4, 27:20, 31:9, 32:22, 33:2, 35:11, 36:11, 40:21</p> <p>accounts [5] - 26:8, 26:21, 31:15, 98:20</p> <p>accuracy [3] - 108:3,</p>	<p>162:5, 162:6</p> <p>accurate [2] - 115:14, 115:15</p> <p>achieve [1] - 153:7</p> <p>ACKERMAN [1] - 4:5</p> <p>Act [2] - 127:11, 128:21</p> <p>act [2] - 68:15</p> <p>acted [1] - 17:16</p> <p>Action [4] - 1:4, 1:10, 201:7, 201:8</p> <p>action [1] - 83:21</p> <p>actions [6] - 20:23, 21:9, 21:12, 21:18, 21:24, 22:19</p> <p>active [5] - 28:12, 29:3, 29:5, 34:23, 34:25</p> <p>actively [2] - 15:25, 36:5</p> <p>actual [12] - 124:7, 131:25, 137:16, 137:25, 143:1, 153:11, 169:24, 180:16, 180:21, 182:12, 184:19, 192:7</p> <p>add [1] - 53:8</p> <p>addicted [8] - 120:6, 120:24, 121:22, 126:3, 126:6, 126:10, 126:16, 134:4</p> <p>addiction [8] - 18:6, 59:21, 120:12, 120:16, 120:22, 121:6, 126:7, 126:22</p> <p>addictions [1] - 126:14</p> <p>addictive [2] - 121:14, 121:17</p> <p>addition [3] - 8:10, 30:16, 32:11</p> <p>additional [3] - 8:14, 35:18, 169:2</p> <p>address [1] - 9:13</p> <p>addressed [1] - 182:1</p> <p>addresses [1] - 38:11</p> <p>adds [1] - 169:2</p> <p>adjourn [1] - 200:7</p> <p>adjustment [2] - 112:13, 115:19</p> <p>admissibility [1] - 182:4</p> <p>admissible [1] - 182:6</p> <p>admission [3] - 47:11, 47:14, 47:17</p> <p>admitted [5] - 26:9, 47:19, 47:20, 51:3, 52:21</p>	<p>adopted [1] - 18:19</p> <p>adult [9] - 73:8, 78:22, 80:25, 88:7, 97:8, 131:15, 131:17, 131:19, 132:14</p> <p>adults [1] - 73:5</p> <p>advanced [1] - 35:1</p> <p>advise [1] - 159:6</p> <p>advised [1] - 130:14</p> <p>affect [6] - 11:5, 19:24, 22:6, 119:24, 171:6</p> <p>affected [2] - 111:22, 122:9</p> <p>affecting [1] - 68:18</p> <p>affectionately [1] - 192:4</p> <p>affiliated [3] - 60:16, 60:17, 60:23</p> <p>affiliation [1] - 61:22</p> <p>afield [1] - 145:10</p> <p>afternoon [8] - 130:19, 131:4, 131:5, 148:9, 150:22, 150:24, 167:7, 187:13</p> <p>age [15] - 28:12, 90:14, 91:7, 91:20, 92:17, 93:20, 93:24, 94:7, 94:17, 94:18, 95:8, 95:11, 102:20</p> <p>Agent [1] - 187:22</p> <p>agents [1] - 195:25</p> <p>ages [5] - 85:24, 94:12, 95:17, 102:9, 102:24</p> <p>aggregate [1] - 68:15</p> <p>ago [8] - 32:3, 67:1, 78:10, 125:9, 125:10, 149:17, 165:22, 170:24</p> <p>agree [7] - 126:4, 126:17, 132:7, 133:6, 136:13, 137:4, 190:16</p> <p>Agreed [2] - 193:13, 193:20</p> <p>agreed [10] - 125:7, 126:11, 127:14, 128:18, 132:12, 132:16, 132:25, 137:6, 139:3, 139:8</p> <p>agreement [2] - 31:6, 43:3</p> <p>ahead [19] - 14:17, 55:11, 106:18, 106:19, 106:21, 116:9, 134:25, 145:14, 147:7, 148:9, 165:7,</p>	<p>182:15, 187:10, 189:11, 189:12, 190:1, 191:14, 196:20, 200:1</p> <p>al [4] - 1:7, 1:13, 201:6, 201:7</p> <p>Alberta [1] - 156:6</p> <p>alcohol [1] - 122:23</p> <p>alert [1] - 148:10</p> <p>alerted [1] - 148:15</p> <p>algebra [3] - 105:13, 106:22, 107:15</p> <p>algorithm [27] - 159:10, 160:1, 168:3, 168:13, 168:22, 169:2, 169:9, 170:2, 172:10, 172:13, 172:24, 173:3, 173:5, 176:10, 177:5, 184:6, 191:17, 191:23, 192:7, 193:6, 193:14, 193:21, 193:23, 193:25, 194:17, 194:18, 194:22</p> <p>algorithms [28] - 151:23, 152:13, 152:15, 159:1, 159:3, 159:11, 159:12, 159:16, 162:8, 164:23, 165:10, 165:13, 165:14, 180:5, 186:6, 190:10, 190:24, 191:20, 192:2, 192:13, 192:17, 197:10, 197:21, 198:2, 198:6, 198:18, 199:3</p> <p>alleged [1] - 65:15</p> <p>allow [4] - 14:15, 21:17, 47:10, 116:8</p> <p>allowed [1] - 24:4</p> <p>almost [9] - 61:5, 91:14, 114:20, 153:2, 153:24, 173:16, 173:17, 174:4, 174:25</p> <p>alone [1] - 192:5</p> <p>alternative [2] - 18:19, 178:11</p> <p>alters [1] - 116:13</p> <p>AM-WV-02768 [2] - 43:25, 44:2</p> <p>AM-WV-02769 [1] - 43:25</p> <p>AM-WV-02770 [2] - 48:19, 50:24</p>	<p>AM-WV-02771 [2] - 49:20, 50:24</p> <p>American [4] - 30:4, 59:5, 60:9, 60:20</p> <p>Amerisource [8] - 37:13, 37:17, 38:2, 38:6, 38:7, 40:12, 41:7, 41:23</p> <p>Amerisource's [3] - 37:5, 39:12, 41:17</p> <p>AMERISOURCEBERGEN [2] - 1:7, 1:13</p> <p>AmerisourceBergen [13] - 6:2, 24:9, 40:14, 41:8, 44:15, 49:10, 49:15, 52:1, 52:8, 52:24, 54:1, 190:5, 201:6</p> <p>AmerisourceBergen's [9] - 39:20, 40:8, 42:12, 43:12, 46:18, 46:25, 50:3, 52:4, 53:4</p> <p>amount [12] - 50:18, 65:7, 65:10, 90:11, 129:5, 129:6, 131:24, 141:9, 172:21, 180:16, 184:15, 200:3</p> <p>amounts [1] - 31:18</p> <p>analogous [1] - 127:2</p> <p>analyses [10] - 17:7, 37:4, 37:8, 37:10, 84:8, 155:10, 155:12, 157:8, 160:24, 178:15</p> <p>analysis [64] - 17:1, 17:3, 17:4, 17:6, 17:10, 17:17, 17:24, 18:17, 19:7, 37:25, 38:25, 39:19, 39:20, 44:23, 45:17, 47:25, 48:22, 48:24, 51:23, 53:5, 53:6, 53:11, 53:14, 53:15, 53:18, 54:4, 70:7, 72:17, 84:4, 85:12, 86:18, 87:5, 90:13, 103:11, 116:23, 122:10, 128:20, 129:20, 151:12, 155:22, 156:3, 156:12, 157:18, 158:5, 160:14, 160:17, 166:15, 171:9, 173:4, 173:8, 173:15, 173:18, 177:12, 179:12, 179:16, 179:24, 180:23, 182:19,</p>
---	---	---	---	---

184:12, 185:6, 185:12, 185:19, 194:13 analyst [2] - 179:9, 184:10 analysts [1] - 179:5 analytics [7] - 27:23, 36:12, 40:22, 57:15, 156:23, 157:6, 178:24 analyze [7] - 27:9, 27:15, 32:4, 78:2, 134:11, 179:14, 185:1 analyzed [6] - 32:7, 41:2, 41:9, 72:11, 157:3, 164:17 analyzing [5] - 28:25, 31:21, 92:14, 156:21, 178:17 ancillary [1] - 123:4 ANDREW [1] - 5:10 Angeles [1] - 56:10 ANNE [1] - 4:2 ANNIE [1] - 4:11 annoying [1] - 47:5 answer [9] - 11:13, 21:2, 21:4, 21:6, 70:13, 86:15, 115:5, 147:7, 198:12 answered [1] - 64:2 answers [1] - 178:21 ANTHONY [1] - 2:6 anti [1] - 34:10 anti-terrorism [1] - 34:10 anticipated [1] - 69:8 antidepressants [1] - 42:15 antitrust [3] - 61:17, 157:2 apart [4] - 86:15, 95:19, 101:3, 101:4 apologize [1] - 24:2 appear [1] - 45:20 APPEARANCES [6] - 2:1, 3:1, 5:1, 5:6, 6:1, 6:10 applicable [2] - 16:4, 16:7 application [19] - 159:2, 159:10, 159:13, 159:25, 160:2, 160:25, 162:7, 164:23, 172:13, 176:24, 184:5, 190:10, 190:23, 191:20, 192:1, 192:13, 192:17, 198:2, 199:3	applied [11] - 42:20, 43:4, 106:5, 107:14, 159:9, 172:4, 176:7, 186:3, 186:6, 191:4, 198:18 applies [5] - 108:9, 113:5, 151:20, 151:22, 188:17 apply [3] - 170:13, 176:15, 191:16 applying [8] - 71:7, 102:16, 102:19, 110:13, 115:8, 155:21, 169:1, 170:1 appreciate [2] - 117:13, 150:2 approach [5] - 42:20, 43:4, 43:9, 104:8, 174:10 appropriate [9] - 22:10, 36:19, 53:16, 150:3, 159:1, 159:18, 159:24, 165:5, 196:18 appropriately [1] - 159:7 appropriateness [1] - 165:3 April [1] - 168:5 arbitration [3] - 29:15, 31:5, 31:7 Arch [2] - 6:6, 6:13 ARCOS [31] - 38:3, 39:3, 39:4, 41:24, 42:3, 42:4, 43:2, 44:22, 45:8, 49:7, 51:23, 52:5, 53:3, 53:7, 75:19, 132:3, 132:5, 151:13, 151:21, 161:10, 161:14, 161:16, 161:19, 161:21, 172:4, 176:8, 185:7, 185:8, 192:14, 198:3, 198:18 area [10] - 9:5, 9:8, 23:12, 27:4, 30:15, 57:16, 58:22, 59:19, 181:6, 184:24 areas [6] - 59:10, 59:21, 128:24, 156:14, 157:16, 161:18 arena [1] - 192:21 argue [1] - 106:10 argument [2] - 127:21, 136:12 argumentative [1] - 127:16 arithmetic [1] - 105:8	Army [2] - 33:17, 33:21 arrest [1] - 123:17 arriving [1] - 43:6 Arrow [1] - 60:12 article [2] - 123:15, 124:6 articles [3] - 59:2, 59:8, 157:12 Arts [1] - 60:20 ascribing [1] - 87:2 ASHLEY [1] - 5:3 aside [3] - 98:15, 112:11, 141:7 aspects [2] - 64:16 assembled [1] - 162:15 assertion [1] - 109:13 assess [3] - 128:20, 152:14, 162:10 assessing [3] - 145:8, 160:1, 199:5 assessment [1] - 139:18 asset [1] - 30:2 assets [1] - 30:7 assign [1] - 16:11 assigned [2] - 26:6, 26:21 assignment [4] - 16:22, 20:14, 20:17, 23:14 assist [6] - 27:9, 34:14, 72:16, 157:2, 185:11, 185:19 assisting [1] - 30:13 associated [9] - 71:21, 84:16, 85:5, 85:20, 85:21, 88:25, 113:7, 124:21, 177:5 Associates [7] - 60:18, 61:8, 61:9, 61:21, 151:9, 156:7, 156:9 association [27] - 69:10, 69:25, 70:19, 70:23, 71:2, 71:4, 71:9, 71:11, 71:13, 71:23, 71:25, 72:3, 72:4, 72:6, 72:8, 75:2, 75:3, 75:4, 75:22, 75:23, 76:8, 88:17, 88:18, 135:6, 138:16, 138:21 associations [2] - 76:1, 76:2 assume [16] - 54:13, 109:6, 130:18, 135:22, 135:24, 136:3, 136:5,	136:11, 136:14, 136:24, 137:10, 137:12, 137:13, 137:20, 142:18, 175:3 assumes [4] - 115:9, 153:21, 169:4, 175:6 assuming [2] - 22:12, 142:12 assumption [55] - 22:8, 115:19, 116:13, 116:22, 142:6, 153:2, 153:4, 153:24, 159:17, 169:2, 169:8, 169:11, 169:13, 169:21, 170:1, 170:2, 170:11, 170:13, 170:15, 170:20, 170:23, 171:3, 171:6, 171:9, 171:13, 172:1, 172:18, 172:19, 172:23, 173:2, 173:4, 173:6, 173:13, 173:16, 173:18, 173:25, 174:2, 174:12, 175:5, 175:6, 175:14, 175:18, 176:1, 176:5, 176:9, 176:13, 176:16, 176:25, 177:2, 177:4, 177:9, 177:13, 177:14, 178:7, 178:12 assumptions [10] - 116:16, 116:18, 153:16, 153:17, 153:20, 159:11, 159:20, 178:2, 188:17, 189:1 asthma [1] - 42:16 AT [1] - 1:2 attempt [3] - 17:14, 128:20, 194:12 attempted [2] - 103:25, 192:7 attempting [1] - 127:5 attend [2] - 33:5, 33:11 attention [1] - 7:18 audit [6] - 25:15, 26:4, 26:5, 26:9, 26:11, 26:19 auditing [2] - 26:8, 32:24 auditor [1] - 31:4 audits [1] - 26:6 augment [1] - 161:20	August [4] - 168:13, 168:16, 168:23, 169:17 authored [4] - 58:24, 58:25, 59:1 authority [1] - 14:13 authorization [2] - 18:10, 18:23 automatic [9] - 169:13, 170:11, 171:20, 172:1, 172:17, 172:23, 173:6, 173:12, 173:24 automatically [2] - 171:5, 172:22 availability [4] - 98:19, 118:21, 143:1, 143:10 available [13] - 17:13, 52:6, 54:13, 122:21, 123:2, 142:20, 142:21, 143:8, 143:20, 144:24, 145:19, 183:7 average [7] - 95:11, 95:13, 113:10, 138:13, 139:5, 193:5, 193:7 averaging [1] - 194:14 Avin [1] - 3:7 avoid [1] - 123:20 award [1] - 34:18 awarded [2] - 60:8, 60:12 awards [3] - 34:16, 60:5, 60:14 aware [20] - 12:9, 15:4, 16:6, 17:23, 17:25, 20:12, 20:15, 29:18, 52:3, 120:17, 144:12, 163:11, 164:6, 170:22, 185:22, 186:2, 188:4, 189:14, 189:17, 190:21 awhile [1] - 60:10 axes [2] - 138:10 axis [7] - 73:1, 73:2, 73:5, 88:8, 88:13, 88:14, 118:17 Ayme [2] - 6:17, 201:2
B				
BA [1] - 56:9 Bachelor [1] - 25:8 Bachelor's [2] - 36:2, 156:5 background [6] -				

<p>25:4, 25:6, 33:13, 35:11, 35:25, 51:19</p> <p>backgrounds [1] - 35:12</p> <p>backup [2] - 166:8, 166:14</p> <p>balance [1] - 168:18</p> <p>ball [1] - 147:21</p> <p>Bankruptcy [1] - 33:9</p> <p>bar [6] - 46:17, 46:20, 49:23, 172:8, 172:10, 172:11</p> <p>Baron [1] - 3:14</p> <p>bars [5] - 46:11, 172:8, 173:17, 174:2, 177:2</p> <p>base [2] - 69:7, 190:7</p> <p>baseball [1] - 198:22</p> <p>based [39] - 40:17, 45:17, 53:25, 64:20, 69:3, 87:5, 87:6, 102:13, 102:15, 103:17, 106:3, 106:23, 109:20, 110:22, 120:21, 124:6, 139:19, 141:8, 149:20, 156:11, 157:18, 163:10, 163:20, 164:5, 166:9, 166:13, 166:23, 167:5, 169:7, 170:8, 170:21, 172:23, 173:21, 174:23, 176:21, 180:2, 183:6, 186:1, 196:16</p> <p>Based [1] - 197:10</p> <p>basic [3] - 35:1, 107:14, 126:2</p> <p>basis [18] - 19:6, 21:16, 87:21, 131:20, 132:14, 153:3, 153:23, 159:1, 159:15, 165:5, 170:12, 170:19, 174:3, 182:6, 183:2, 183:3, 191:6, 191:9</p> <p>Bates [1] - 60:7</p> <p>battalion [1] - 34:3</p> <p>Baylen [1] - 2:11</p> <p>bear [1] - 116:25</p> <p>became [1] - 28:4</p> <p>Becker [3] - 57:4, 120:15, 125:16</p> <p>become [5] - 26:17, 126:16, 132:9, 142:20, 156:2</p> <p>becomes [4] - 89:9, 143:8, 143:20,</p>	<p>145:19</p> <p>beer [2] - 198:9, 198:13</p> <p>BEFORE [1] - 1:17</p> <p>began [1] - 142:7</p> <p>beginning [2] - 73:9, 123:10</p> <p>begins [2] - 81:13, 81:15</p> <p>behalf [2] - 26:23, 29:25</p> <p>behave [1] - 97:22</p> <p>behaves [2] - 73:7, 99:5</p> <p>behavior [14] - 8:4, 58:8, 65:9, 65:10, 67:4, 69:15, 74:17, 84:21, 86:9, 87:7, 87:9, 87:10, 89:24</p> <p>behind [2] - 76:16, 77:16</p> <p>believes [2] - 151:23, 166:25</p> <p>bell [1] - 94:10</p> <p>below [2] - 49:7, 168:24</p> <p>BENCH [1] - 1:16</p> <p>beneficial [1] - 123:18</p> <p>benefit [2] - 153:16, 156:20</p> <p>best [1] - 30:1</p> <p>better [6] - 30:23, 36:15, 79:19, 114:6, 125:21, 132:7</p> <p>between [47] - 8:21, 11:2, 37:20, 43:10, 52:25, 53:3, 57:22, 62:7, 65:20, 69:10, 69:25, 70:19, 71:2, 71:11, 71:19, 71:23, 72:12, 73:18, 73:19, 74:8, 77:4, 77:14, 78:23, 81:17, 85:8, 87:15, 88:13, 90:6, 90:14, 92:25, 95:1, 98:6, 99:1, 99:10, 102:9, 109:21, 112:22, 114:11, 119:18, 128:21, 134:18, 136:4, 137:22, 138:7, 138:8, 147:18</p> <p>beyond [12] - 13:11, 14:10, 16:9, 16:22, 21:1, 22:25, 23:14, 28:17, 58:19, 89:25, 115:23, 116:4</p> <p>big [8] - 8:4, 64:3, 71:7, 71:23, 80:22, 84:2, 99:11, 103:6</p>	<p>bigger [1] - 83:9</p> <p>biggest [8] - 91:5, 91:18, 91:22, 94:24, 95:14, 99:10, 102:6, 110:9</p> <p>billet [1] - 34:8</p> <p>biology [1] - 25:8</p> <p>bit [14] - 8:5, 39:18, 57:8, 57:20, 67:1, 70:25, 71:3, 75:21, 78:16, 119:1, 148:13, 156:17, 170:24, 182:2</p> <p>black [20] - 74:19, 78:24, 79:8, 82:15, 94:13, 94:16, 94:18, 94:19, 95:2, 95:24, 97:1, 98:10, 99:25, 100:5, 100:9, 132:16, 133:13, 133:25, 134:1, 140:6</p> <p>blackboards [1] - 104:13</p> <p>black [4] - 129:12, 163:13, 189:15, 189:16</p> <p>blocked [9] - 164:7, 164:9, 164:11, 164:15, 170:18, 170:25, 171:2, 190:6, 190:7</p> <p>blocking [1] - 162:25</p> <p>blood [1] - 42:14</p> <p>blossomed [1] - 9:23</p> <p>blue [29] - 44:8, 44:13, 45:13, 45:14, 45:22, 46:11, 49:6, 49:9, 73:6, 73:19, 78:25, 80:14, 81:6, 81:10, 82:16, 95:5, 95:23, 95:25, 97:1, 97:8, 97:10, 100:24, 118:23, 132:4, 133:12, 133:25, 172:14, 173:17</p> <p>Bldv [3] - 4:3, 4:12, 4:14</p> <p>board [5] - 35:18, 72:20, 72:22, 104:5, 104:9</p> <p>Board [3] - 14:8, 14:25, 15:22</p> <p>Boberg [48] - 150:16, 151:5, 151:7, 152:6, 155:9, 158:4, 158:14, 160:7, 160:12, 160:15, 164:18, 166:19, 167:11, 167:18, 169:12, 170:8,</p>	<p>170:21, 171:4, 171:11, 171:17, 171:19, 171:23, 172:16, 173:11, 173:21, 175:11, 175:19, 175:22, 176:15, 176:21, 177:23, 177:25, 178:14, 179:4, 180:8, 181:12, 181:14, 181:23, 182:18, 183:6, 184:10, 185:16, 185:22, 186:17, 187:4, 187:20, 199:10, 199:12</p> <p>BOBERG [1] - 150:19</p> <p>bodies [2] - 62:25, 63:4</p> <p>body [1] - 136:11</p> <p>Bonasso [1] - 5:14</p> <p>books [3] - 59:24, 59:25, 60:3</p> <p>Booth [2] - 56:21, 57:17</p> <p>bore [1] - 146:24</p> <p>bored [1] - 146:25</p> <p>Boston [1] - 156:11</p> <p>bother [1] - 139:13</p> <p>bottom [5] - 52:23, 53:9, 93:8, 112:9, 119:8</p> <p>Boulevard [1] - 3:15</p> <p>bound [1] - 115:5</p> <p>Box [2] - 5:14</p>
---	--	---	--

<p>22:23, 23:11, 37:5, 37:15, 38:8, 38:18, 38:21, 39:21, 40:5, 40:12, 41:9, 41:17, 43:12, 44:11, 44:15, 46:9, 46:18, 49:5, 49:11, 49:15, 49:25, 50:4, 50:9, 52:24, 65:15, 103:12, 103:20, 103:24, 110:13, 110:15, 110:17, 110:21, 114:23, 141:10, 151:22, 154:20, 155:14, 161:10, 172:6, 175:16, 176:8, 184:6, 185:3, 186:11, 186:18, 197:14, 198:3, 198:7, 198:9</p> <p>CABELL [1] - 1:10</p> <p>cabell [1] - 2:2</p> <p>Cabell-Huntington [4] - 40:5, 103:20, 103:24, 114:23</p> <p>calculate [8] - 17:18, 104:2, 173:22, 176:21, 183:21, 186:9, 186:14, 186:22</p> <p>calculated [1] - 186:23</p> <p>calculates [1] - 186:24</p> <p>calculating [1] - 109:18</p> <p>calculation [9] - 30:7, 54:10, 99:3, 108:12, 108:13, 111:3, 111:4, 111:19, 155:15</p> <p>calculations [3] - 43:1, 43:3, 112:11</p> <p>calibrate [2] - 109:19, 113:25</p> <p>calibrated [1] - 110:9</p> <p>calibration [2] - 109:20, 111:10</p> <p>California [2] - 34:12, 56:10</p> <p>CALLAS [1] - 6:7</p> <p>CAMPBELL [1] - 6:14</p> <p>campus [1] - 32:18</p> <p>Canada [1] - 156:6</p> <p>cannot [2] - 19:22, 144:2</p> <p>cap [2] - 129:7, 129:8</p> <p>capacity [6] - 28:16, 28:18, 28:22, 29:4, 29:6, 32:12</p> <p>capita [1] - 87:21</p>	<p>Capitol [1] - 2:7</p> <p>caplets [1] - 49:3</p> <p>capsules [1] - 49:3</p> <p>Cardinal [6] - 4:16, 5:2, 161:12, 163:12, 164:7, 199:17</p> <p>care [6] - 15:6, 19:2, 19:10, 19:15, 19:18, 22:5</p> <p>career [7] - 59:1, 60:6, 63:23, 71:7, 156:13, 156:24, 157:11</p> <p>careful [4] - 80:10, 119:10, 135:18, 146:19</p> <p>Carey [1] - 4:23</p> <p>carries [1] - 109:5</p> <p>cars [1] - 118:18</p> <p>case [64] - 9:12, 10:6, 11:8, 11:17, 12:1, 14:8, 14:24, 17:9, 20:21, 22:22, 32:7, 42:24, 54:18, 65:14, 67:13, 71:19, 74:5, 83:1, 91:19, 104:2, 108:15, 118:7, 118:12, 142:24, 152:4, 152:8, 155:2, 155:17, 155:20, 161:4, 161:15, 161:22, 162:18, 163:1, 163:2, 163:10, 164:6, 164:12, 164:14, 165:20, 166:5, 166:24, 168:11, 170:9, 170:22, 171:12, 176:22, 179:19, 180:2, 180:24, 181:4, 181:15, 186:2, 188:1, 188:9, 188:21, 189:4, 190:14, 195:25, 196:4, 196:5, 197:6, 198:1</p> <p>cases [7] - 8:19, 31:25, 61:18, 138:11, 155:23, 156:14, 161:21</p> <p>Casey [1] - 122:7</p> <p>cash [13] - 19:22, 19:24, 20:1, 20:4, 20:10, 20:12, 20:16, 20:23, 21:12, 22:1, 22:4, 22:13, 22:19</p> <p>categories [1] - 134:15</p> <p>category [4] - 79:15, 79:16, 81:8, 109:2</p>	<p>causal [2] - 77:3, 77:8</p> <p>causality [3] - 71:20, 71:22, 85:17</p> <p>causation [3] - 71:2, 71:24, 75:2</p> <p>causative [1] - 19:6</p> <p>caused [7] - 8:1, 10:19, 70:2, 70:21, 71:22, 86:16, 151:24</p> <p>causing [1] - 137:11</p> <p>CDC [3] - 8:3, 19:10, 102:21</p> <p>ceiling [1] - 121:1</p> <p>Cendant [1] - 31:13</p> <p>Center [8] - 3:12, 5:11, 33:8, 34:12, 34:14, 181:3, 185:23, 186:12</p> <p>certain [4] - 37:4, 130:20, 164:8, 166:25</p> <p>certainly [11] - 8:2, 16:15, 18:11, 18:13, 61:10, 63:17, 71:6, 76:24, 109:8, 146:25, 181:23</p> <p>Certainly [2] - 18:9, 36:16</p> <p>certainty [1] - 51:8</p> <p>CERTIFICATION [1] - 201:1</p> <p>certified [2] - 25:16, 25:19</p> <p>certify [1] - 201:4</p> <p>chain [12] - 34:2, 34:6, 58:14, 63:25, 99:16, 99:17, 99:19, 99:24, 127:10, 157:1, 158:21, 186:7</p> <p>chalkboard [1] - 104:20</p> <p>chance [4] - 51:16, 65:16, 89:3, 148:23</p> <p>change [12] - 19:13, 19:14, 19:18, 26:24, 37:20, 80:1, 92:5, 111:11, 127:5, 135:20, 137:14, 137:21</p> <p>changed [5] - 29:2, 112:22, 133:16, 135:14</p> <p>changes [11] - 19:2, 19:5, 19:7, 19:8, 19:9, 37:22, 59:15, 98:17, 115:20, 116:18</p> <p>changing [1] - 116:13</p> <p>channel [16] - 153:12, 154:25, 180:17,</p>	<p>180:22, 182:21, 182:23, 183:23, 184:9, 184:16, 184:19, 195:12, 195:15, 195:17, 195:21, 197:2, 197:5</p> <p>characterization [1] - 90:17</p> <p>characterize [1] - 198:2</p> <p>charge [1] - 35:23</p> <p>Charles [8] - 60:17, 61:8, 61:9, 61:15, 61:21, 151:9, 156:7, 156:9</p> <p>CHARLES [1] - 3:11</p> <p>Charleston [6] - 2:8, 3:13, 4:24, 5:15, 6:9, 7:3</p> <p>CHARLESTON [2] - 1:2, 1:18</p> <p>chart [46] - 45:3, 45:25, 46:6, 46:7, 46:11, 46:23, 47:25, 48:1, 48:22, 48:24, 49:1, 49:19, 49:21, 49:23, 53:6, 72:24, 73:1, 78:21, 79:22, 80:25, 81:1, 81:23, 81:25, 83:7, 94:7, 96:1, 96:22, 96:23, 96:24, 96:25, 97:2, 99:2, 100:13, 100:14, 100:21, 100:23, 101:8, 102:2, 173:9, 173:12, 176:3, 176:18, 181:14, 182:2, 186:15, 194:11</p> <p>charts [15] - 48:6, 48:13, 48:25, 54:16, 82:12, 82:13, 83:17, 171:11, 171:19, 171:23, 173:22, 175:19, 175:24, 176:22, 178:5</p> <p>Chase [1] - 4:23</p> <p>cheap [2] - 100:6, 123:1</p> <p>cheaper [3] - 66:16, 121:25, 122:6</p> <p>check [13] - 42:25, 54:12, 130:19, 179:5, 179:7, 179:9, 180:3, 180:6, 180:22, 181:1, 181:8, 182:19</p> <p>checking [1] - 180:9</p> <p>checks [1] - 179:25</p>	<p>chemically [1] - 80:11</p> <p>Chesterbrook [1] - 6:15</p> <p>Chicago [13] - 56:7, 56:11, 56:14, 56:15, 56:24, 57:7, 57:11, 60:15, 104:19, 106:10, 106:11, 127:14, 145:10</p> <p>childhood [2] - 9:20, 9:21</p> <p>children [1] - 93:8</p> <p>choices [1] - 159:12</p> <p>chooses [1] - 68:21</p> <p>cigarettes [1] - 121:9</p> <p>circled [1] - 133:7</p> <p>circling [1] - 48:5</p> <p>Circuit [2] - 188:1, 188:12</p> <p>circumstances [1] - 27:11</p> <p>cite [1] - 11:19</p> <p>cited [5] - 59:9, 59:11, 59:18, 59:21, 59:23</p> <p>City [25] - 4:1, 5:11, 37:5, 37:15, 38:8, 38:18, 38:21, 39:21, 40:12, 41:9, 41:17, 43:13, 44:11, 44:15, 46:9, 46:19, 49:5, 49:11, 49:16, 49:25, 50:4, 50:9, 65:16, 103:12, 201:5</p> <p>CITY [1] - 1:4</p> <p>city [1] - 23:12</p> <p>Civil [3] - 1:4, 201:7, 201:8</p> <p>civil [2] - 1:10, 34:9</p> <p>Claims [1] - 29:24</p> <p>claims [3] - 12:23, 29:24, 30:8</p> <p>clarify [4] - 86:14, 147:5, 174:4, 188:16</p> <p>clarifying [1] - 81:24</p> <p>clarity [1] - 169:7</p> <p>Clark [1] - 60:7</p> <p>class [2] - 60:2, 146:24</p> <p>classification [1] - 26:7</p> <p>claw [2] - 30:14, 30:16</p> <p>clear [19] - 10:6, 13:10, 18:23, 32:6, 42:3, 45:12, 49:9, 52:3, 73:18, 75:15, 80:2, 86:17, 88:24, 112:17, 112:18, 120:13, 144:16, 182:5, 193:14</p> <p>cleared [2] - 189:16,</p>
--	---	--	--	---

<p>190:7 clearly [1] - 62:9 CLERK [9] - 24:14, 24:16, 24:19, 55:16, 55:18, 55:21, 150:14, 150:17, 150:20 client [4] - 28:18, 29:4, 29:6 clinical [2] - 18:14, 18:15 Closed [1] - 64:12 closed [8] - 14:6, 14:23, 15:15, 15:17, 127:10, 158:21, 183:8, 183:18 closely [2] - 35:20, 35:22 closer [3] - 12:4, 94:4, 147:13 closings [1] - 148:25 CMS [1] - 181:2 co [2] - 58:24, 59:1 co-authored [2] - 58:24, 59:1 Coca [1] - 143:11 Coca-Cola [1] - 143:11 Cochran [3] - 6:17, 201:2, 201:11 code [8] - 38:13, 162:2, 166:12, 173:1, 173:2, 173:3, 190:7, 197:13 codes [2] - 41:23, 41:24 coefficients [1] - 89:5 coke [1] - 143:11 Coke [11] - 143:9, 143:10, 143:12, 143:14, 143:15, 143:17, 143:18, 144:10, 145:24, 147:23, 147:24 Cola [1] - 143:11 cola [1] - 147:24 colleague [1] - 122:7 College [2] - 32:17 Colombia [1] - 100:2 Colonel [2] - 33:17, 55:2 colored [3] - 172:10, 172:12, 172:14 Columbia [3] - 106:12, 188:2, 188:13 combat [1] - 33:18 combinations [1] - 132:21 combine [1] - 101:25 combined [1] - 80:13</p>	<p>combining [1] - 102:2 Coming [1] - 35:4 coming [3] - 77:9, 141:22, 148:9 command [2] - 34:2, 34:6 Commander [1] - 34:9 commendations [1] - 34:16 comments [1] - 159:20 COMMISSION [1] - 1:10 Commission [5] - 2:2, 3:2, 63:10, 155:25, 157:2 commitment [1] - 130:17 commodities [1] - 121:20 common [3] - 132:10, 157:7, 180:24 commonly [1] - 17:1 communities [2] - 124:2, 125:1 community [4] - 68:6, 69:11, 70:1, 70:20 companies [4] - 8:11, 26:6, 26:13, 63:6 company [2] - 28:1, 54:15 comparable [1] - 200:4 compare [3] - 37:21, 53:20, 155:2 compared [10] - 41:24, 42:9, 50:19, 54:1, 113:7, 122:17, 153:9, 180:19, 184:4, 186:19 comparing [3] - 94:3, 181:8, 183:17 comparison [1] - 183:16 compilations [1] - 32:25 compiled [1] - 100:14 complement [3] - 147:19, 147:20, 147:22 complements [1] - 146:23 complete [4] - 40:10, 41:16, 56:8, 161:3 completely [2] - 97:22, 164:25 complex [1] - 124:11 complicated [4] - 18:8, 23:8, 94:9, 128:7</p>	<p>comply [1] - 16:4 component [1] - 58:14 components [1] - 58:17 comprised [1] - 30:3 computer [4] - 6:19, 35:13, 36:3 concept [4] - 16:15, 71:5, 145:18, 189:15 concepts [1] - 97:2 concerning [1] - 161:3 concerns [1] - 181:25 concise [1] - 123:15 conclude [2] - 142:8, 152:21 concluded [1] - 153:14 conclusion [15] - 16:5, 16:10, 39:15, 78:9, 89:21, 90:5, 92:24, 93:2, 96:1, 98:4, 103:1, 103:2, 115:18, 116:12, 140:10 conclusions [3] - 91:3, 149:1, 149:16 conditional [1] - 135:8 conduct [8] - 13:9, 16:6, 70:2, 70:21, 85:6, 179:24, 181:1, 185:5 conducted [3] - 180:23, 181:8, 183:16 conducting [1] - 162:25 confer [1] - 148:23 confidentiality [1] - 9:4 confined [3] - 11:7, 13:8, 38:25 confused [1] - 158:24 confusing [1] - 129:17 Congress [1] - 62:19 congressional [1] - 195:5 connected [1] - 184:8 connection [7] - 34:19, 64:11, 152:8, 161:22, 171:11, 181:15, 188:6 connections [1] - 188:5 Connolly [2] - 4:18, 5:4 CONROY [1] - 3:3 consequences [1] - 124:16 consider [3] - 27:17, 27:19, 27:22</p>	<p>considered [4] - 17:7, 28:15, 41:13, 41:25 considers [1] - 20:12 consistency [1] - 124:19 consistent [8] - 42:20, 43:9, 50:12, 50:14, 50:16, 184:18, 197:3 consists [1] - 161:8 consolidation [1] - 30:19 constitutes [1] - 136:16 construct [2] - 137:17, 137:24 constructed [1] - 105:10 consult [1] - 61:12 consultancy [4] - 28:18, 28:22, 29:4, 29:6 consultant [2] - 60:18, 61:8 consulted [1] - 63:8 consulting [6] - 8:10, 8:14, 61:10, 61:11, 61:15, 156:11 consume [6] - 66:14, 69:20, 121:24, 126:5, 126:16 consumed [2] - 69:18, 76:23 consumer's [1] - 65:23 consumers [2] - 119:14, 124:2 consuming [3] - 90:25, 93:5, 126:7 consumption [7] - 65:21, 66:9, 88:15, 126:8, 126:14, 126:20, 126:22 consumptions [1] - 122:9 contain [1] - 137:9 contains [1] - 48:23 context [7] - 107:2, 156:21, 157:3, 157:25, 190:3, 197:25, 198:19 continue [6] - 28:23, 131:6, 149:12, 162:15, 191:6, 196:17 Continued [5] - 3:1, 5:1, 5:6, 6:1, 6:10 continued [1] - 28:15 contract [2] - 124:21, 124:22 contracting [1] -</p>	<p>128:15 contradicting [1] - 101:18 contrary [1] - 170:22 contributing [1] - 16:14 control [5] - 10:12, 17:20, 18:16, 21:21 controlled [26] - 14:6, 14:22, 15:2, 15:6, 16:1, 18:2, 64:13, 64:23, 65:8, 153:12, 154:25, 158:18, 180:16, 180:21, 182:21, 182:23, 183:23, 184:9, 184:15, 184:19, 195:12, 195:15, 195:17, 195:21, 197:2, 197:5 Controlled [2] - 127:11, 128:21 controlling [1] - 18:12 controls [2] - 10:13, 18:19 convenient [1] - 55:8 Cook [3] - 6:18, 201:3, 201:11 Coopers [5] - 25:14, 26:2, 27:25, 28:2, 33:21 core [3] - 35:10, 35:11, 57:15 cORPORATION [2] - 1:7, 1:13 Corporation [2] - 6:2, 201:7 Correct [6] - 15:23, 16:18, 28:17, 28:24, 38:19, 41:8 correct [160] - 7:23, 7:24, 8:1, 8:8, 8:12, 8:15, 8:23, 8:24, 9:2, 9:3, 9:6, 9:9, 9:10, 9:13, 9:14, 9:17, 9:25, 10:2, 10:3, 10:12, 10:20, 10:24, 11:6, 11:9, 11:17, 11:20, 11:21, 11:23, 12:1, 12:7, 12:8, 12:10, 12:11, 12:20, 13:3, 13:4, 13:6, 13:23, 14:2, 15:1, 15:8, 15:12, 15:13, 15:15, 16:4, 16:12, 16:24, 16:25, 17:2, 17:10, 17:11, 17:16, 17:17, 17:20, 17:24, 17:25, 18:3, 18:7, 19:3, 19:22, 20:11,</p>
--	--	---	--	--

<p>20:24, 21:13, 22:2, 22:10, 22:20, 22:21, 22:24, 23:3, 23:4, 23:7, 28:6, 29:2, 29:11, 31:19, 32:7, 32:8, 32:9, 32:10, 38:18, 38:22, 38:23, 39:1, 39:22, 39:23, 40:4, 41:4, 41:5, 41:11, 41:12, 42:5, 42:6, 44:16, 44:17, 45:15, 45:16, 45:24, 46:19, 46:20, 46:22, 46:23, 46:24, 47:2, 47:4, 48:7, 48:11, 48:12, 49:12, 49:13, 49:17, 49:18, 50:6, 50:7, 50:10, 50:11, 51:23, 51:24, 52:2, 52:25, 53:1, 75:16, 94:22, 112:25, 115:11, 117:3, 118:24, 119:21, 127:6, 132:3, 132:17, 138:9, 138:17, 139:9, 139:15, 152:20, 154:10, 154:12, 154:13, 161:20, 163:9, 165:24, 165:25, 166:21, 166:22, 169:11, 173:10, 174:7, 174:8, 176:13, 176:14, 177:6, 177:7, 178:23, 185:3, 185:4, 185:9, 185:10, 190:16, 193:5, 201:4</p> <p>corrected [7] - 21:20, 21:22, 112:11, 114:16, 114:24, 114:25, 115:1</p> <p>correcting [1] - 114:16</p> <p>correctly [7] - 20:1, 45:13, 46:16, 46:17, 109:22, 110:8, 113:11</p> <p>correlated [1] - 132:24</p> <p>correlation [9] - 88:19, 88:20, 89:1, 89:5, 89:8, 90:9, 90:10, 134:18, 135:4</p> <p>correspond [2] - 108:14, 108:23</p> <p>corresponding [2] - 105:20, 105:21</p> <p>corroborated [1] - 179:16</p> <p>cost [3] - 18:6, 18:16,</p>	<p>100:8</p> <p>costly [2] - 123:3, 125:14</p> <p>costs [9] - 118:21, 122:24, 123:4, 123:7, 123:10, 124:1, 124:24, 124:25, 125:2</p> <p>counsel [4] - 14:13, 27:7, 27:10, 170:14</p> <p>counted [1] - 91:9</p> <p>counterfactual [1] - 137:2</p> <p>counties [1] - 53:20</p> <p>countless [1] - 30:13</p> <p>countries [2] - 30:5, 125:1</p> <p>country [10] - 30:9, 30:12, 54:2, 54:5, 86:8, 86:9, 86:25, 98:9, 139:2, 139:8</p> <p>county [2] - 10:5, 53:23</p> <p>COUNTY [1] - 1:10</p> <p>County [59] - 2:2, 3:2, 9:16, 9:24, 13:6, 13:22, 23:11, 37:5, 37:15, 38:8, 38:18, 38:21, 39:21, 40:12, 41:9, 41:17, 43:13, 44:11, 44:15, 46:9, 46:18, 49:5, 49:11, 49:16, 49:25, 50:4, 50:9, 52:24, 53:13, 54:2, 65:15, 103:12, 110:14, 110:15, 110:17, 110:21, 141:10, 151:22, 154:20, 155:14, 161:10, 172:6, 175:16, 176:8, 184:6, 185:3, 186:11, 186:18, 192:6, 192:8, 194:13, 196:10, 196:12, 196:22, 197:8, 197:14, 198:4, 198:7, 198:10</p> <p>couple [6] - 28:22, 43:15, 51:21, 131:11, 131:12, 158:15</p> <p>course [7] - 57:14, 60:6, 63:5, 149:12, 149:21, 156:23, 157:11</p> <p>courses [3] - 57:11, 60:2, 133:16</p> <p>COURT [113] - 1:1, 1:17, 7:5, 7:8, 7:11,</p>	<p>7:13, 13:12, 13:17, 14:14, 21:2, 21:17, 23:16, 23:18, 23:20, 23:22, 23:25, 24:6, 24:8, 24:12, 34:23, 36:13, 36:18, 36:23, 40:15, 40:20, 47:16, 47:19, 51:1, 51:3, 51:12, 54:23, 54:25, 55:2, 55:7, 55:11, 55:13, 55:23, 57:6, 63:14, 63:19, 70:11, 81:19, 104:10, 106:14, 106:18, 115:24, 116:1, 116:8, 117:9, 117:12, 117:15, 127:17, 127:19, 127:22, 129:16, 129:24, 130:2, 130:4, 130:9, 130:12, 130:21, 131:1, 131:4, 131:6, 134:24, 141:19, 141:25, 145:13, 146:6, 147:6, 147:18, 147:25, 148:3, 148:7, 149:15, 149:20, 149:25, 150:3, 150:8, 150:13, 150:22, 151:1, 158:7, 158:9, 158:11, 160:4, 160:7, 160:15, 160:21, 163:24, 165:5, 182:3, 182:10, 182:14, 182:24, 183:1, 187:2, 187:8, 187:18, 189:10, 189:19, 189:25, 191:11, 191:14, 196:13, 196:19, 199:8, 199:10, 199:12, 199:20, 199:25, 200:5, 200:9</p> <p>court [4] - 29:18, 30:15, 117:12, 135:10</p> <p>Court [52] - 6:17, 6:18, 7:2, 17:4, 24:25, 25:7, 26:3, 27:2, 29:21, 31:11, 32:2, 32:15, 33:9, 33:16, 33:24, 37:25, 41:15, 42:19, 44:5, 44:18, 46:6, 50:22, 55:8, 56:3, 56:23, 103:22, 148:10, 149:13, 150:1, 151:6,</p>	<p>151:16, 152:19, 154:18, 156:22, 159:6, 160:7, 165:19, 166:21, 167:10, 167:22, 171:24, 173:11, 174:22, 176:4, 183:16, 184:25, 185:13, 187:21, 188:1, 188:13, 201:2, 201:3</p> <p>Court's [1] - 153:16</p> <p>Courtroom [1] - 32:21</p> <p>courtroom [2] - 7:6, 149:10</p> <p>COURTROOM [6] - 55:16, 55:18, 55:21, 150:14, 150:17, 150:20</p> <p>courts [3] - 27:10, 123:25, 155:24</p> <p>cover [1] - 58:15</p> <p>coverage [2] - 8:1, 16:8</p> <p>Covington [1] - 5:11</p> <p>CPA [1] - 26:11</p> <p>CPAs [1] - 32:23</p> <p>CRA [3] - 156:9, 156:13, 158:1</p> <p>Craig [2] - 39:6, 39:8</p> <p>created [1] - 115:2</p> <p>creeping [1] - 81:14</p> <p>crime [1] - 122:20</p> <p>criteria [2] - 158:25, 159:15</p> <p>critically [1] - 177:13</p> <p>criticizing [1] - 106:11</p> <p>critique [1] - 154:15</p> <p>cross [18] - 14:14, 23:16, 51:12, 72:6, 72:9, 87:11, 90:3, 106:15, 117:9, 133:9, 133:10, 148:14, 182:12, 183:1, 183:4, 187:3, 189:8, 189:10</p> <p>CROSS [5] - 7:16, 51:13, 117:17, 158:12, 187:11</p> <p>cross-examination [2] - 14:14, 189:10</p> <p>cross-examine [1] - 51:12</p> <p>cross-section [1] - 90:3</p> <p>cross-sectional [2] - 72:6, 72:9</p> <p>cross-sectionally [1] - 87:11</p> <p>CRR [2] - 6:17, 6:18</p>	<p>cumulative [2] - 163:15, 193:15</p> <p>current [1] - 123:12</p> <p>curve [8] - 94:11, 95:15, 95:21, 118:25, 119:1, 119:7, 121:23, 122:5</p> <p>customers [9] - 19:22, 19:24, 21:25, 22:18, 38:11, 39:21, 40:9, 50:4, 58:12</p> <p>cut [1] - 98:11</p>
				D
				<p>damages [1] - 61:18</p> <p>data [177] - 11:22, 11:25, 12:3, 12:13, 12:23, 12:25, 13:3, 13:5, 13:21, 13:24, 13:25, 14:1, 14:4, 16:20, 17:7, 17:21, 20:5, 20:8, 20:9, 23:6, 26:15, 27:22, 28:25, 31:18, 31:21, 32:4, 32:7, 32:9, 36:12, 37:24, 37:25, 38:2, 38:3, 38:4, 38:6, 38:14, 39:4, 39:13, 40:22, 41:2, 41:6, 41:7, 41:8, 41:20, 41:23, 41:25, 42:3, 42:4, 42:8, 42:9, 42:12, 42:23, 43:2, 43:12, 43:21, 44:20, 49:3, 49:7, 49:8, 51:23, 52:1, 52:4, 52:5, 52:6, 52:8, 52:9, 52:14, 52:15, 53:4, 53:25, 54:3, 54:17, 71:8, 73:16, 75:18, 87:14, 91:24, 92:10, 92:11, 93:6, 93:11, 97:14, 98:8, 100:14, 102:14, 102:15, 102:21, 102:25, 105:11, 109:23, 110:10, 111:12, 111:13, 113:11, 124:16, 132:3, 132:5, 134:11, 138:16, 151:13, 151:21, 155:22, 156:3, 156:23, 157:4, 157:6, 157:18, 159:8, 160:16, 161:10, 161:11, 161:14, 161:16, 161:17, 161:19, 161:20,</p>

<p>161:21, 162:4, 162:8, 162:10, 162:11, 162:12, 162:20, 163:7, 164:11, 164:13, 164:17, 164:19, 164:23, 165:3, 165:12, 165:13, 172:5, 176:8, 177:11, 178:17, 178:24, 179:5, 179:7, 179:9, 179:12, 179:16, 179:24, 180:3, 180:23, 181:1, 181:3, 181:8, 182:12, 182:19, 183:16, 184:3, 184:10, 185:7, 185:8, 185:9, 186:24, 188:25, 191:4, 191:17, 191:24, 192:8, 192:14, 192:16, 194:16, 195:7, 198:3, 198:6, 198:19</p> <p>dataset [17] - 73:9, 161:1, 161:3, 161:6, 161:8, 161:23, 161:25, 162:3, 162:5, 162:15, 162:16, 162:21, 162:22, 163:21, 165:9, 165:10, 167:25</p> <p>datasets [8] - 27:13, 27:15, 36:16, 40:19, 156:21, 158:6, 160:14, 160:17</p> <p>Date [1] - 201:16</p> <p>DAVID [2] - 1:17, 4:5</p> <p>David [1] - 7:1</p> <p>days [1] - 136:9</p> <p>DC [6] - 4:7, 4:10, 4:19, 4:21, 5:5, 5:12</p> <p>De [2] - 2:4, 2:14</p> <p>DEA [33] - 14:8, 14:11, 14:25, 15:20, 20:12, 154:24, 161:11, 180:17, 181:5, 181:9, 181:19, 181:20, 182:18, 182:20, 183:7, 183:8, 183:11, 183:14, 183:17, 183:21, 184:14, 184:19, 187:22, 188:9, 189:3, 189:8, 189:14, 195:3, 195:18, 195:19,</p>	<p>195:20, 195:24, 197:1</p> <p>DEA's [7] - 153:10, 153:13, 180:20, 182:22, 183:22, 184:11, 195:11</p> <p>dealer [1] - 100:10</p> <p>dealers [1] - 100:7</p> <p>dealing [4] - 42:16, 42:24, 43:5, 158:18</p> <p>deals [1] - 128:8</p> <p>death [14] - 83:14, 89:18, 90:6, 94:8, 105:6, 105:9, 105:10, 108:3, 108:7, 108:19, 108:23, 109:2, 109:23, 123:21</p> <p>deaths [39] - 74:21, 78:22, 94:23, 95:9, 104:1, 105:1, 105:7, 105:10, 105:14, 105:17, 105:20, 105:23, 105:24, 107:17, 107:18, 108:7, 108:8, 108:12, 108:13, 108:16, 108:21, 108:23, 109:4, 109:21, 110:13, 111:10, 111:22, 111:24, 113:14, 114:25, 115:3, 117:4, 132:16, 132:20, 132:25, 133:15, 138:14, 141:2</p> <p>debate [2] - 117:21, 136:9</p> <p>decade [1] - 141:5</p> <p>decide [2] - 67:22, 68:21</p> <p>deciding [2] - 68:10, 68:11</p> <p>decision [6] - 11:6, 68:9, 74:4, 74:6, 74:18, 171:4</p> <p>decisions [2] - 68:16, 84:23</p> <p>decline [4] - 73:10, 73:20, 79:24, 97:15</p> <p>declined [1] - 73:15</p> <p>declines [3] - 79:11, 81:16, 82:19</p> <p>decreasing [2] - 18:6, 112:8</p> <p>defendant [6] - 23:9, 161:12, 161:19, 172:6, 190:11, 192:14</p>	<p>Defendant [4] - 4:16, 5:2, 5:7, 6:2</p> <p>defendants [12] - 11:16, 23:11, 131:8, 148:11, 161:15, 162:17, 163:11, 163:16, 163:23, 164:6, 190:4, 192:20</p> <p>Defendants [3] - 1:8, 1:14, 201:7</p> <p>DEFENDANTS' [2] - 7:9, 24:18</p> <p>DEFENSE [2] - 55:20, 150:19</p> <p>defense [3] - 8:23, 55:5, 55:14</p> <p>define [4] - 135:25, 136:6, 136:7, 136:15</p> <p>defined [2] - 92:7, 198:16</p> <p>definitely [1] - 10:13</p> <p>definition [2] - 105:12, 198:13</p> <p>degree [3] - 51:7, 56:11, 56:16</p> <p>degrees [1] - 35:13</p> <p>delivered [2] - 129:22, 129:23</p> <p>demand [37] - 58:11, 58:16, 66:4, 66:5, 66:18, 66:19, 66:24, 74:2, 77:4, 117:25, 118:2, 118:10, 118:14, 118:17, 119:17, 119:24, 120:5, 120:9, 121:15, 121:20, 121:22, 122:5, 126:1, 126:17, 126:18, 126:19, 126:20, 126:21, 126:22, 126:24, 127:4, 127:12, 129:2, 129:11</p> <p>demanding [1] - 119:15</p> <p>Demarest [1] - 25:2</p> <p>DEMAREST [1] - 25:2</p> <p>Demo [1] - 167:15</p> <p>demonstrate [1] - 132:22</p> <p>demonstrates [1] - 197:7</p> <p>Demonstrative [9] - 152:2, 166:17, 169:19, 171:17, 174:15, 175:23, 177:23, 181:12, 185:16</p> <p>demonstrative [19] -</p>	<p>72:15, 152:7, 155:7, 167:18, 167:21, 167:24, 168:17, 168:19, 169:20, 170:6, 177:18, 177:25, 179:2, 181:7, 181:14, 184:22, 185:11, 185:18, 197:24</p> <p>demonstratives [1] - 131:8</p> <p>denominator [2] - 109:16, 112:9</p> <p>Department [9] - 29:23, 30:1, 56:6, 56:22, 57:17, 63:9, 106:11, 106:12, 155:25</p> <p>departments [1] - 56:20</p> <p>dependent [1] - 172:10</p> <p>depicted [1] - 72:24</p> <p>depicting [1] - 173:22</p> <p>depiction [5] - 40:11, 172:3, 173:15, 176:6, 183:20</p> <p>depo [1] - 149:12</p> <p>deponent [1] - 190:18</p> <p>deposed [1] - 195:25</p> <p>deposition [8] - 16:13, 29:14, 62:9, 166:4, 166:6, 189:22, 190:18, 191:1</p> <p>DEPUTY [6] - 55:16, 55:18, 55:21, 150:14, 150:17, 150:20</p> <p>derive [1] - 113:22</p> <p>describe [32] - 25:6, 30:1, 31:11, 35:7, 37:25, 38:4, 44:5, 44:18, 46:5, 48:21, 49:21, 61:8, 62:21, 63:2, 72:23, 74:20, 79:7, 81:11, 97:3, 98:24, 99:18, 101:5, 103:22, 112:15, 118:8, 155:19, 167:21, 173:11, 174:22, 175:20, 176:4, 181:17</p> <p>described [2] - 48:25, 167:9</p> <p>descriptions [1] - 166:13</p> <p>designated [1] - 189:23</p> <p>designations [1] - 149:12</p>	<p>designed [2] - 18:1, 158:16</p> <p>destroyed [1] - 125:1</p> <p>detail [6] - 78:8, 86:13, 87:13, 96:17, 118:6, 151:17</p> <p>detailed [1] - 42:23</p> <p>details [3] - 38:6, 38:10, 110:7</p> <p>detect [3] - 18:2, 197:10, 197:21</p> <p>determinant [1] - 77:11</p> <p>determinants [1] - 127:8</p> <p>determination [1] - 154:4</p> <p>determine [8] - 41:19, 54:8, 67:3, 68:5, 74:15, 154:24, 172:21, 186:17</p> <p>determined [4] - 39:12, 65:9, 74:6, 118:20</p> <p>determines [3] - 65:10, 65:12, 88:7</p> <p>detour [1] - 33:12</p> <p>develop [2] - 64:21, 65:2</p> <p>developed [2] - 63:24, 151:20</p> <p>diagram [4] - 118:11, 127:5, 138:5, 138:14</p> <p>Dickinson [1] - 25:9</p> <p>die [2] - 79:13, 123:22</p> <p>differ [2] - 162:22, 163:8</p> <p>difference [7] - 71:23, 96:3, 96:4, 102:6, 147:18, 178:1, 178:4</p> <p>differences [9] - 86:24, 87:12, 90:14, 93:20, 96:13, 102:9, 115:7, 145:3, 145:16</p> <p>different [52] - 26:8, 33:13, 35:16, 38:12, 42:15, 42:16, 59:10, 61:16, 65:20, 71:4, 72:3, 76:2, 82:9, 86:7, 86:8, 92:23, 93:25, 96:20, 97:23, 97:25, 100:25, 105:24, 107:18, 114:3, 116:22, 119:4, 120:1, 120:6, 120:8, 120:23, 123:16, 128:12, 128:16, 133:23, 135:21, 145:17, 153:6, 153:7,</p>
--	---	--	---	--

153:13, 156:14, 156:15, 165:1, 175:5, 178:19, 178:21, 179:13, 190:3, 190:17, 194:20 differently [1] - 17:16 differing [1] - 98:6 difficult [1] - 19:13 diligence [4] - 162:25, 170:16, 171:1, 190:8 dimension [3] - 72:9, 72:10, 110:9 dimensions [2] - 85:12, 102:4 dire [2] - 158:8, 158:10 direct [5] - 13:8, 21:1, 128:13, 130:9, 141:25 DIRECT [3] - 24:20, 55:25, 151:3 direction [4] - 112:3, 125:12, 125:15, 135:8 directly [6] - 19:22, 68:7, 68:18, 142:22, 163:16, 190:13 Directly [1] - 19:23 disagree [1] - 80:22 disciplines [1] - 70:8 discover [1] - 66:15 discuss [2] - 138:4, 139:12 discussed [3] - 31:17, 112:12, 161:1 discussing [3] - 68:4, 92:9, 102:8 discussion [1] - 87:6 discussions [2] - 11:2, 136:7 disentangle [1] - 19:13 disparity [1] - 138:15 dispensed [1] - 68:12 dispensing [2] - 12:25, 18:15 dispute [1] - 128:18 disputes [1] - 27:6 disruptive [1] - 122:24 distinct [1] - 75:5 distinction [5] - 65:19, 71:19, 99:10, 102:23, 103:7 distinctions [1] - 57:22 Distinguished [1] - 56:5 distribute [3] - 65:5, 65:7, 69:1	distributed [10] - 14:6, 14:23, 23:11, 49:10, 49:25, 50:19, 67:14, 94:12, 99:25 distributing [1] - 68:17 Distribution [1] - 64:13 distribution [21] - 15:15, 45:18, 46:18, 46:25, 50:3, 50:15, 64:23, 65:6, 66:22, 93:24, 94:3, 94:7, 102:23, 127:10, 128:15, 128:17, 156:19, 158:22, 185:2, 186:10, 194:10 distributor [20] - 11:9, 11:16, 23:4, 37:14, 68:19, 68:22, 69:15, 85:18, 89:24, 159:23, 161:15, 161:17, 161:20, 162:17, 163:11, 167:25, 169:3, 188:23, 190:14, 192:14 distributor's [1] - 68:9 distributors [42] - 9:2, 11:5, 11:22, 12:1, 12:3, 12:6, 12:9, 12:20, 12:22, 13:2, 13:9, 13:11, 13:20, 14:7, 14:24, 15:4, 15:5, 15:8, 15:11, 16:20, 22:22, 23:10, 64:22, 68:5, 70:24, 77:8, 77:10, 86:16, 128:6, 128:11, 128:12, 128:14, 128:22, 129:12, 151:21, 161:9, 161:12, 162:24, 172:5, 172:6, 186:19, 192:2 distributors' [5] - 11:19, 65:4, 70:2, 70:21, 190:11 District [5] - 7:2, 7:3, 33:8, 188:1, 188:13 DISTRICT [3] - 1:1, 1:1, 1:17 diuretics [1] - 42:15 divergence [1] - 100:19 diversion [21] - 15:25, 18:2, 18:6, 20:13, 20:15, 153:11, 154:24, 180:16,	180:21, 181:20, 182:21, 182:23, 183:18, 183:22, 184:8, 184:15, 184:19, 195:12, 195:14, 195:20, 197:2 diversions [1] - 141:14 diverted [10] - 15:6, 20:10, 68:13, 141:10, 183:8, 183:21, 195:4, 195:17, 196:25, 197:4 diverting [2] - 140:6, 140:13 divide [1] - 87:18 divided [3] - 105:14, 183:23, 195:15 dividing [1] - 107:12 division [1] - 34:3 divisions [1] - 83:4 Dix [1] - 34:4 doctor [10] - 11:2, 51:17, 67:22, 67:25, 74:8, 126:12, 128:2, 151:5, 152:6, 183:6 Doctor [39] - 21:4, 51:15, 141:22, 151:8, 151:15, 151:25, 152:16, 155:5, 155:16, 156:2, 156:22, 157:7, 157:11, 158:3, 160:24, 161:13, 161:22, 163:10, 164:3, 165:17, 170:4, 172:21, 174:9, 174:13, 174:17, 174:20, 174:22, 175:24, 176:3, 177:8, 177:15, 178:25, 181:7, 184:20, 185:11, 185:18, 186:9, 186:25, 197:6 doctor/patient [2] - 10:23, 11:6 doctors [8] - 20:19, 67:21, 68:2, 74:4, 74:6, 74:7, 74:9, 195:6 document [1] - 47:11 documentary [1] - 179:18 documents [3] - 11:19, 15:19, 47:17 done [36] - 8:10, 8:14,	11:8, 12:6, 17:23, 19:6, 24:3, 59:16, 59:20, 61:16, 61:17, 61:18, 61:19, 61:20, 64:7, 74:8, 79:22, 80:2, 82:16, 83:3, 84:8, 117:3, 121:10, 122:7, 122:8, 141:13, 148:13, 155:20, 170:16, 171:1, 173:21, 192:12, 194:2, 194:5 dosage [12] - 42:21, 43:1, 43:7, 44:10, 49:4, 53:10, 53:12, 168:1, 168:6, 168:14, 190:22, 193:11 doses [1] - 196:22 dot [2] - 88:5, 138:25 dots [1] - 138:20 doubt [1] - 140:25 doughnuts [2] - 67:10, 67:11 Douglas [1] - 4:23 Dow [3] - 112:23, 112:24, 112:25 down [26] - 10:4, 27:8, 45:23, 49:14, 66:15, 67:9, 71:17, 75:10, 75:25, 76:5, 76:15, 77:19, 80:7, 83:2, 99:7, 104:10, 111:17, 133:15, 139:14, 143:2, 148:13, 155:6, 170:5, 179:1, 182:25, 184:21 downstream [1] - 65:7 downward [2] - 121:24, 122:5 DR [1] - 55:20 dr [1] - 171:4 Dr [255] - 7:6, 7:18, 23:15, 23:20, 23:22, 38:3, 39:12, 40:20, 42:8, 51:22, 52:12, 52:13, 55:6, 55:14, 56:2, 56:8, 56:23, 57:9, 57:19, 58:19, 60:5, 61:7, 63:12, 63:23, 67:16, 70:13, 70:19, 71:1, 72:11, 72:22, 74:20, 76:18, 78:17, 80:20, 80:24, 81:23, 82:6, 82:12, 83:12, 84:4, 84:18, 88:2, 92:9, 94:6, 98:14, 98:24, 100:14, 101:13,	102:14, 103:9, 103:11, 103:18, 103:23, 104:8, 104:10, 104:22, 104:23, 106:3, 106:19, 106:21, 107:14, 107:24, 108:1, 108:4, 108:18, 109:12, 109:15, 111:20, 111:22, 112:13, 114:18, 115:14, 116:6, 116:11, 117:7, 123:14, 130:5, 130:17, 130:22, 131:2, 131:4, 131:11, 142:5, 143:24, 146:4, 146:10, 148:1, 148:3, 151:13, 151:20, 152:13, 152:16, 152:17, 153:3, 153:12, 153:20, 154:6, 154:11, 154:19, 155:3, 155:9, 155:14, 158:4, 158:14, 159:1, 159:2, 159:7, 159:9, 159:16, 159:20, 159:25, 160:7, 160:12, 160:15, 160:24, 161:1, 161:2, 161:7, 161:8, 161:13, 161:16, 161:23, 161:25, 162:2, 162:5, 162:7, 162:8, 162:12, 162:16, 163:21, 164:13, 164:17, 164:18, 164:19, 165:4, 165:23, 166:1, 166:6, 166:9, 166:10, 166:13, 166:15, 166:19, 167:11, 167:18, 167:19, 167:22, 168:3, 168:22, 169:1, 169:9, 169:12, 169:14, 169:24, 170:2, 170:8, 170:9, 170:12, 170:19, 170:21, 170:23, 171:3, 171:4, 171:11, 171:13, 171:19, 171:23, 171:25, 172:3, 172:4, 172:10, 172:12, 172:16,
--	---	--	--	---

172:22, 172:25, 173:11, 173:13, 173:17, 173:21, 173:23, 174:3, 174:5, 174:9, 174:23, 175:8, 175:11, 175:19, 175:25, 176:5, 176:7, 176:10, 176:15, 176:19, 176:21, 176:23, 177:15, 177:19, 177:25, 178:1, 178:8, 178:11, 178:14, 178:15, 178:20, 179:4, 180:3, 180:8, 180:9, 180:13, 180:20, 181:9, 181:14, 181:23, 182:1, 182:18, 182:19, 183:17, 184:5, 184:10, 184:11, 184:13, 184:17, 185:7, 185:22, 186:1, 186:3, 186:6, 186:17, 186:24, 187:4, 187:20, 188:17, 188:24, 188:25, 190:9, 190:23, 191:20, 192:1, 192:13, 192:17, 193:6, 194:3, 194:16, 194:17, 194:18, 198:1, 198:16, 199:1, 199:3, 199:10, 199:12 dramatic [2] - 169:23, 169:24 dramatically [3] - 101:3, 135:14, 178:18 drank [1] - 142:14 draw [12] - 89:22, 90:5, 91:3, 92:24, 93:2, 96:1, 98:4, 103:2, 115:18, 116:12, 131:14, 139:1 drawing [1] - 129:9 drawn [1] - 188:6 drew [1] - 122:1 drill [4] - 78:8, 78:15, 86:13, 87:13 drilling [1] - 27:8 drink [5] - 143:12, 143:18, 147:24 drinking [4] - 142:12, 143:13, 143:16,	143:17 drive [3] - 58:16, 87:4, 118:18 Drive [1] - 6:15 driven [8] - 54:14, 78:12, 83:20, 84:20, 87:9, 118:17, 126:14, 153:2 driver [3] - 66:24, 67:15, 116:20 drives [1] - 153:24 driving [7] - 77:21, 80:16, 85:17, 90:1, 99:17, 101:15, 127:13 drop [2] - 148:21, 167:6 drought [1] - 71:16 drove [2] - 84:6, 84:23 DRUG [2] - 1:7, 1:13 drug [25] - 9:1, 37:14, 38:12, 38:13, 41:25, 42:1, 45:8, 49:8, 80:8, 98:17, 98:18, 100:7, 100:10, 101:14, 101:16, 104:1, 109:7, 109:13, 131:22, 132:1, 136:1, 144:1, 144:2, 168:1, 169:4 Drug [2] - 6:2, 201:7 drugs [28] - 10:2, 42:16, 43:5, 43:8, 44:22, 45:18, 46:22, 48:8, 59:20, 79:20, 101:19, 103:3, 121:10, 121:14, 122:14, 123:9, 123:19, 125:7, 125:21, 129:22, 144:19, 144:25, 145:17, 157:5, 163:3, 184:2, 195:13 due [9] - 162:25, 170:16, 171:1, 173:24, 174:2, 176:24, 177:2, 177:4, 190:8 during [11] - 34:16, 45:11, 53:15, 60:5, 61:21, 76:19, 94:20, 102:11, 149:21, 156:13, 157:11 duties [4] - 15:11, 15:12, 15:25, 128:20 duty [3] - 16:17, 34:23, 35:1 dying [9] - 85:23, 85:24, 90:21, 94:2, 94:4, 139:17,	139:22, 139:25, 140:23 E early [10] - 45:6, 59:14, 86:9, 86:21, 86:23, 87:3, 87:25, 90:20, 148:14, 148:15 easier [1] - 98:13 east [28] - 97:4, 97:10, 97:13, 97:15, 97:24, 98:1, 98:6, 98:20, 99:4, 99:6, 99:7, 99:9, 99:14, 99:20, 100:3, 100:17, 100:19, 100:23, 101:11, 103:7, 110:20, 111:1, 111:7, 113:19, 113:24, 137:5, 137:8, 137:11 East [3] - 3:5, 3:12, 4:24 eastern [6] - 96:20, 98:12, 111:12, 111:14, 114:6, 114:9 easy [1] - 63:25 Econometric [2] - 60:23, 60:24 econometrics [6] - 155:22, 156:2, 157:12, 158:5, 160:13, 160:16 economic [22] - 10:25, 53:12, 59:22, 61:11, 69:12, 70:6, 84:8, 84:24, 85:1, 103:4, 106:9, 116:17, 122:13, 123:17, 124:7, 127:7, 127:12, 129:13, 138:22, 143:20, 156:11 Economic [4] - 59:5, 61:2, 61:4, 145:10 Economics [8] - 56:5, 56:6, 56:22, 57:17, 59:6, 106:11, 156:4, 156:5 economics [51] - 56:13, 56:25, 57:1, 57:13, 57:22, 57:25, 58:15, 58:20, 58:22, 59:7, 59:17, 59:18, 59:24, 59:25, 60:6, 60:13, 62:12, 62:16, 63:12, 63:13, 63:20, 63:21, 64:6, 64:17,	64:18, 64:22, 65:19, 68:23, 69:8, 70:10, 70:22, 71:1, 71:6, 71:7, 74:3, 75:14, 100:6, 106:23, 116:18, 117:21, 119:19, 129:3, 138:24, 144:21, 144:22, 146:13, 146:15, 146:18, 155:21, 157:18, 179:23 economist [16] - 16:24, 60:9, 63:24, 64:17, 65:18, 107:2, 115:18, 116:7, 116:12, 117:22, 118:7, 129:19, 134:9, 140:10, 151:9, 156:13 economists [5] - 57:4, 66:13, 124:11, 129:21, 157:9 Economists [2] - 17:1, 60:21 economy [2] - 57:24, 118:18 Economy [1] - 59:5 edited [1] - 60:3 education [2] - 56:8, 59:16 educational [3] - 25:5, 25:6, 35:25 effect [10] - 8:4, 112:4, 113:3, 116:24, 126:19, 136:12, 169:23, 169:24, 183:20, 190:5 effective [4] - 18:24, 18:25, 123:13, 125:23 effort [1] - 107:3 Eighth [1] - 3:10 either [9] - 55:10, 58:25, 71:22, 86:3, 87:11, 102:9, 107:21, 110:8, 113:14 elastic [3] - 120:13, 120:14, 120:20 elasticity [5] - 119:1, 119:3, 120:13, 121:11, 121:16 elders [1] - 117:21 elements [2] - 115:10, 116:23 elicited [1] - 70:6 ELIZABETH [1] - 6:14 embarrass [1] - 118:5 empirical [3] - 120:12,	124:14, 146:20 empirically [1] - 147:2 employed [4] - 151:8, 161:7, 169:13, 170:23 employees [1] - 11:16 Encino [1] - 3:16 end [13] - 47:14, 123:3, 123:5, 124:24, 136:25, 139:2, 142:22, 143:3, 147:8, 149:5, 149:9, 150:7, 164:16 ended [1] - 142:11 ending [1] - 149:5 enforcement [2] - 124:21, 124:22 engaged [2] - 103:11, 124:1 engagements [6] - 27:5, 27:6, 29:1, 33:25, 62:11, 63:5 engineer [3] - 33:18, 34:3 ensures [1] - 175:14 entire [4] - 46:17, 46:20, 169:6, 196:5 entirely [2] - 153:2, 173:17 entities [3] - 10:22, 10:23, 63:7 entitled [1] - 32:20 ENU [1] - 4:17 enumerator [1] - 112:8 environment [1] - 128:24 epidemic [4] - 9:22, 16:12, 16:21, 17:19 epidemiology [4] - 70:8, 106:23, 116:5, 145:11 Epidemiology [1] - 106:12 equal [5] - 105:3, 105:15, 110:4, 119:10, 119:12 equality [1] - 59:15 equation [2] - 105:13, 105:15 equilibrium [6] - 118:2, 118:11, 119:20, 119:22, 119:25, 120:1 equivalence [2] - 131:25, 132:1 equivalent [3] - 131:19, 131:23, 131:24 erase [2] - 104:15,
---	--	---	---	---

104:17 eraser [1] - 104:16 erasing [1] - 139:13 Ernst [2] - 31:12, 31:13 error [1] - 109:15 errors [4] - 109:17, 111:21, 112:4, 112:7 especially [1] - 63:20 essence [1] - 18:17 essentially [10] - 10:11, 38:6, 46:9, 88:20, 89:12, 89:15, 153:4, 166:12, 173:1, 175:14 establish [4] - 70:20, 77:7, 175:2, 181:22 established [1] - 70:2 establishing [1] - 136:12 estimate [28] - 29:17, 103:11, 103:19, 107:3, 107:6, 108:8, 108:10, 108:24, 110:15, 111:23, 114:5, 114:6, 114:10, 114:19, 114:22, 115:14, 115:21, 116:13, 117:5, 117:6, 154:23, 180:18, 180:21, 182:20, 183:8, 183:22, 195:14, 195:16 estimated [2] - 103:23, 113:1 estimates [17] - 111:16, 112:6, 117:1, 153:11, 153:12, 153:13, 180:19, 182:23, 183:7, 183:11, 183:17, 184:11, 184:18, 195:3, 195:11, 195:20, 197:1 estimating [3] - 108:2, 108:15, 184:14 estimation [1] - 108:19 et [4] - 1:7, 1:13, 201:6, 201:7 evaluate [6] - 76:8, 84:12, 84:24, 85:11, 154:12, 162:7 evaluates [1] - 193:23 evaluating [1] - 76:9 evaluation [3] - 33:3, 157:3, 184:11 evening [1] - 24:4	events [2] - 143:25, 144:3 evidence [35] - 17:12, 20:21, 21:10, 22:22, 23:2, 23:9, 47:17, 50:24, 67:13, 83:25, 85:1, 85:2, 103:4, 120:12, 136:11, 136:15, 136:23, 140:16, 143:19, 144:13, 144:16, 145:11, 146:21, 153:10, 154:22, 163:10, 163:20, 164:5, 170:21, 170:22, 179:17, 179:18, 181:24, 182:5, 182:9 Evidence [2] - 47:15, 50:25 evolved [1] - 22:5 exact [2] - 99:3, 115:12 exactly [9] - 92:18, 97:9, 97:12, 105:11, 107:7, 114:10, 144:4, 149:24 examination [3] - 14:14, 187:4, 189:10 EXAMINATION [10] - 7:16, 24:20, 51:13, 55:25, 117:17, 142:3, 146:8, 151:3, 158:12, 187:11 examinations [1] - 148:14 examine [5] - 51:12, 106:15, 117:9, 182:13, 183:1 example [28] - 19:10, 65:8, 66:11, 71:11, 71:19, 74:13, 74:15, 77:7, 94:13, 116:21, 119:22, 121:15, 122:8, 128:17, 129:22, 135:14, 143:9, 145:24, 154:8, 156:25, 159:23, 169:23, 181:2, 181:5, 193:9, 194:7, 196:7, 196:20 examples [5] - 29:21, 146:22, 156:22, 164:15, 196:9 exceed [3] - 168:15, 168:20, 174:6 exceeds [2] - 168:10, 193:15 excess [3] - 155:4, 184:17, 193:12	excessively [1] - 169:25 Excuse [2] - 8:13, 11:24 excused [3] - 23:20, 54:25, 199:10 exercise [4] - 34:19, 109:20, 180:8, 180:12 exhibit [5] - 72:23, 78:15, 78:17, 80:24, 197:6 Exhibit [14] - 52:23, 78:16, 78:18, 82:10, 82:23, 82:24, 88:2, 91:2, 94:6, 98:22, 131:7, 131:13, 137:15, 137:21 exist [1] - 70:23 expand [2] - 57:20, 75:21 expansion [4] - 20:6, 77:23, 77:24, 98:18 expect [8] - 20:6, 69:4, 88:17, 89:3, 105:7, 165:6, 184:14, 197:11 expected [1] - 149:4 experience [8] - 8:6, 31:24, 51:19, 64:20, 100:11, 123:8, 156:17, 156:21 experiences [1] - 34:7 expert [54] - 8:7, 8:16, 8:19, 8:23, 9:3, 9:6, 9:8, 9:15, 27:19, 27:22, 29:7, 29:9, 29:13, 29:22, 29:25, 31:8, 31:13, 31:21, 31:24, 32:9, 32:11, 36:11, 36:16, 39:6, 39:15, 40:21, 62:1, 62:4, 62:11, 62:15, 62:18, 62:24, 63:5, 63:12, 63:17, 63:20, 64:15, 72:16, 72:23, 156:2, 157:19, 158:5, 158:20, 158:23, 159:14, 160:5, 160:8, 160:13, 160:16, 165:6, 181:25, 188:7, 195:20 expertise [8] - 63:24, 64:5, 128:25, 155:19, 157:18, 159:24, 163:15, 195:2 experts [4] - 9:13, 142:24, 145:12,	157:8 explain [26] - 17:4, 26:3, 27:2, 32:2, 32:15, 33:16, 33:24, 41:13, 42:19, 86:17, 88:4, 96:17, 100:15, 102:6, 104:4, 104:22, 137:14, 137:16, 154:17, 163:20, 171:23, 177:19, 178:4, 178:20, 181:8, 183:16 explained [4] - 89:12, 89:15, 89:18, 103:8 explaining [3] - 72:16, 183:2, 185:12 explains [1] - 170:20 explanation [4] - 137:21, 140:5, 140:21, 182:1 explanatory [1] - 88:16 exposed [2] - 126:4, 126:10 extend [1] - 119:22 extended [2] - 28:12, 28:17 extension [1] - 18:24 extent [11] - 17:18, 19:8, 35:15, 54:3, 70:9, 83:10, 83:11, 89:20, 192:15, 194:15, 199:16 extreme [1] - 69:19	32:19 failed [1] - 16:3 fair [14] - 9:21, 10:7, 14:5, 28:16, 58:7, 61:16, 73:22, 90:17, 122:14, 123:19, 124:8, 139:18, 140:20, 146:15 Fair [2] - 15:4, 19:19 faire [1] - 119:19 Fairfield [1] - 25:8 Fairleigh [1] - 25:9 fairly [1] - 184:15 faith [2] - 191:6, 191:9 falling [1] - 133:25 familiar [9] - 10:1, 57:6, 94:10, 103:10, 104:7, 158:20, 188:3, 188:5, 190:11 famous [1] - 57:4 fancy [1] - 104:17 far [6] - 42:17, 52:17, 145:10, 155:3, 170:12, 184:17 FARRELL [69] - 2:3, 36:14, 40:17, 47:9, 47:18, 51:2, 51:14, 52:20, 52:22, 55:1, 63:15, 70:4, 81:20, 92:5, 106:7, 106:17, 115:22, 115:25, 116:3, 117:10, 117:16, 117:18, 118:1, 118:4, 120:3, 121:7, 127:20, 127:23, 129:18, 130:1, 130:3, 130:7, 130:14, 130:20, 131:7, 131:10, 138:2, 138:3, 141:18, 141:21, 145:9, 146:7, 146:9, 147:8, 147:9, 147:17, 158:8, 158:10, 158:13, 160:3, 160:6, 163:14, 164:22, 181:18, 182:8, 182:25, 187:12, 187:15, 187:19, 189:13, 190:2, 191:9, 191:13, 191:15, 192:19, 192:22, 196:21, 199:6, 199:11 Farrell [26] - 2:4, 2:13, 21:20, 51:15, 81:19, 106:15, 116:2, 117:15, 117:19, 129:17, 129:24,
---	---	--	--	---

F

Faber [1] - 7:1
FABER [1] - 1:17
fact [25] - 18:5, 66:19,
86:7, 105:10, 111:3,
115:19, 116:12,
120:12, 120:19,
124:18, 136:5,
136:12, 136:14,
137:14, 140:10,
142:25, 143:6,
146:2, 148:16,
148:25, 163:12,
164:7, 173:5,
191:11, 191:16
factor [3] - 16:14,
88:16, 146:19
factors [5] - 68:4,
103:1, 119:4,
127:13, 137:19
facts [3] - 137:12,
137:14, 137:20
faculty [2] - 32:16,

<p>131:6, 142:5, 146:6, 158:15, 160:5, 169:8, 182:7, 182:12, 182:24, 187:10, 187:13, 189:11, 190:1, 191:6, 196:13 Farrell's [1] - 181:25 fascinating [1] - 112:17 faster [3] - 76:6, 99:9, 99:14 fatal [2] - 137:11, 137:23 fault [4] - 16:12, 16:14, 16:17, 16:21 Fault [1] - 16:14 faults [3] - 52:12, 52:16, 52:17 FCRR [1] - 6:18 February [4] - 168:4, 168:7, 193:10, 193:11 federal [4] - 29:10, 32:12, 63:8, 129:4 Federal [8] - 33:8, 47:15, 50:24, 63:9, 155:25, 157:2 feedback [1] - 126:19 fellow [1] - 60:24 fentanyl [83] - 77:25, 78:3, 78:14, 78:24, 79:1, 79:3, 79:4, 79:14, 79:15, 79:23, 80:9, 80:11, 80:12, 80:13, 80:16, 80:19, 81:3, 81:5, 81:8, 81:9, 81:16, 82:15, 82:20, 83:2, 83:14, 83:20, 83:21, 83:23, 83:24, 84:1, 84:2, 84:3, 84:16, 87:17, 88:11, 95:5, 96:14, 96:19, 98:11, 98:12, 98:19, 99:1, 99:8, 99:11, 99:13, 99:19, 100:5, 100:6, 100:8, 100:9, 100:17, 101:6, 102:13, 109:21, 109:25, 110:1, 110:2, 110:4, 110:5, 110:20, 110:22, 111:1, 112:13, 113:3, 113:4, 113:7, 113:9, 113:11, 115:20, 123:21, 132:19, 137:6, 137:9, 137:10, 138:8, 139:6, 139:8, 141:2,</p>	<p>141:4 fentanyl-related [1] - 78:14 few [12] - 50:16, 59:12, 91:10, 107:25, 130:6, 130:7, 130:8, 143:23, 162:23, 165:22, 170:3, 187:14 fewer [3] - 17:14, 142:23, 143:16 field [10] - 36:3, 56:24, 58:20, 59:9, 62:16, 63:12, 116:4, 129:11, 158:20, 179:23 fields [7] - 40:21, 63:18, 63:20, 157:12, 160:8, 160:13, 160:16 figure [4] - 79:14, 94:13, 94:16, 191:24 figures [2] - 76:16, 92:14 figuring [1] - 178:22 file [1] - 164:9 fill [2] - 65:11, 161:18 filled [4] - 12:7, 69:7, 127:25, 141:15 fills [1] - 67:24 finally [1] - 86:6 Financial [1] - 32:20 financial [6] - 26:7, 26:22, 32:23, 32:24, 33:1, 163:5 findings [3] - 148:25, 149:16, 155:3 fine [1] - 130:24 finish [3] - 23:25, 130:5, 130:12 finished [1] - 56:16 firm [6] - 26:9, 26:23, 27:1, 28:11, 61:10, 156:11 Firm [2] - 3:4, 3:7 firm's [1] - 31:3 firms [3] - 25:14, 31:9, 58:8 First [1] - 192:11 first [28] - 48:25, 73:15, 76:3, 76:18, 77:6, 78:12, 82:25, 85:12, 86:14, 87:14, 96:25, 97:2, 100:23, 102:1, 104:15, 111:21, 117:24, 126:7, 128:3, 131:13, 136:1, 168:4, 170:16, 174:19, 187:15,</p>	<p>199:19, 199:20, 199:22 firsthand [1] - 100:11 fit [9] - 85:2, 85:5, 93:6, 93:11, 103:4, 110:19, 111:12, 113:11, 138:1 fits [1] - 137:25 five [5] - 117:11, 117:13, 135:11, 135:22, 142:6 five-minute [1] - 117:11 fix [2] - 111:5, 120:25 fixed [17] - 111:9, 111:10, 113:17, 113:20, 174:19, 175:7, 175:20, 175:25, 176:4, 176:10, 176:13, 176:16, 176:24, 177:3, 177:8, 178:12 fixing [2] - 111:8, 175:11 FL [1] - 2:11 flag [17] - 7:25, 20:13, 151:23, 165:14, 167:23, 168:23, 169:15, 169:16, 170:3, 171:5, 172:17, 175:3, 175:8, 193:22, 194:2, 194:5 flagged [27] - 153:21, 153:22, 154:9, 168:12, 168:16, 168:19, 168:20, 169:5, 172:22, 173:23, 173:24, 174:5, 175:4, 175:17, 176:20, 176:23, 176:24, 177:4, 177:15, 178:7, 178:8, 180:14, 191:18, 191:25, 193:17, 193:18, 193:20 flagging [39] - 151:12, 151:18, 154:6, 154:19, 155:3, 159:17, 159:18, 165:11, 165:24, 166:2, 166:10, 166:20, 166:25, 169:13, 170:1, 170:11, 171:20, 172:1, 172:11, 172:13, 172:15, 172:18, 172:19, 172:23, 173:6,</p>	<p>173:12, 173:24, 174:10, 176:10, 176:18, 178:9, 178:12, 180:20, 184:7, 184:13, 184:17, 186:1, 186:3, 199:4 flags [4] - 168:20, 169:3, 173:19, 194:22 Flaherty [1] - 5:14 FLAHIVE [1] - 5:10 flat [1] - 81:16 flaws [4] - 112:11, 112:12, 114:25, 115:2 flight [1] - 130:23 Floor [1] - 3:5 focus [10] - 10:7, 27:7, 37:24, 38:8, 39:6, 39:18, 57:21, 58:7, 147:11, 167:6 focused [6] - 48:14, 49:1, 58:5, 61:15, 113:24, 192:1 folks [3] - 95:21, 114:4, 148:21 follow [5] - 21:9, 126:7, 129:1, 134:12, 143:23 follow-up [1] - 129:1 follows [3] - 7:4, 97:13, 187:7 FOR [1] - 1:1 forces [5] - 63:24, 64:9, 66:3, 66:19, 71:23 foregoing [1] - 201:4 forensic [8] - 26:25, 27:2, 27:12, 27:17, 27:19, 33:2, 36:11, 40:21 Forensic [1] - 27:4 forever [1] - 175:7 forget [1] - 149:11 forgot [1] - 60:25 form [26] - 28:3, 38:1, 38:14, 41:3, 41:4, 43:5, 43:7, 43:11, 44:9, 44:24, 44:25, 46:21, 48:7, 48:10, 48:14, 49:2, 49:10, 49:15, 50:8, 78:1, 121:3, 129:14, 158:25, 159:15 formed [2] - 34:8, 34:9 former [1] - 187:22 forms [3] - 32:25, 50:5, 182:6 formula [8] - 105:25,</p>	<p>107:19, 107:21, 109:1, 110:1, 110:16, 113:5, 115:12 formulas [1] - 124:10 Fort [3] - 34:4, 34:20 forth [9] - 27:8, 27:10, 34:14, 35:14, 35:17, 42:9, 54:16, 171:20 fortunate [1] - 57:16 forward [4] - 36:24, 70:4, 149:21, 157:8 fought [1] - 125:18 Foundation [1] - 60:12 foundation [10] - 21:1, 21:15, 106:8, 134:20, 181:19, 181:22, 183:14, 189:7, 189:21, 191:5 four [5] - 19:25, 31:17, 135:11, 135:22, 142:6 fraction [6] - 135:5, 140:18, 172:11, 172:12, 172:15, 195:16 frame [5] - 45:11, 45:20, 53:7, 53:16, 161:17 framed [1] - 70:9 framework [4] - 126:23, 136:22, 154:12, 178:22 framing [1] - 53:2 fraud [1] - 30:18 frauds [1] - 30:11 free [4] - 23:23, 55:3, 182:12, 199:12 freezes [1] - 175:9 Friedman [2] - 57:3, 125:13 friend [1] - 125:17 fuel [1] - 118:18 full [6] - 24:14, 37:13, 37:14, 40:11, 41:16, 130:19 full-line [2] - 37:13, 37:14 FULLER [1] - 2:12 Fuller [2] - 2:4, 2:13 fully [1] - 136:10 function [3] - 66:4, 66:7, 74:1 functional [2] - 35:16 functioning [1] - 29:4 functions [1] - 167:23 funds [1] - 30:17 future [7] - 126:18, 126:20, 126:21,</p>
--	---	---	---	--

126:22, 189:5, 189:16, 190:6	given ^[14] - 9:12, 17:12, 20:6, 22:3, 28:19, 29:14, 62:8, 68:4, 87:3, 115:9, 117:2, 140:11, 174:11, 180:13	guess ^[4] - 13:14, 36:18, 60:9, 133:4	height ^[1] - 172:8	145:14
G		guidance ^[2] - 154:11, 178:22	held ^[1] - 26:6	high ^[10] - 20:15, 20:16, 84:25, 104:13, 109:4, 109:5, 111:21, 112:6, 124:3, 125:2
gaps ^[1] - 161:19	government ^[7] - 63:8, 119:19, 119:23, 119:25, 120:2, 129:4, 180:25	guidelines ^[2] - 8:3, 19:10	help ^[8] - 28:25, 70:18, 104:4, 167:14, 171:13, 175:19, 177:18, 181:8	higher ^[16] - 85:19, 85:20, 85:21, 87:10, 97:15, 110:3, 110:21, 111:1, 111:25, 113:10, 119:9, 119:11, 119:12, 119:15, 120:11, 139:2
Gary ^[3] - 57:4, 120:15, 125:16	government's ^[1] - 129:11	guns ^[1] - 198:14	helpful ^[1] - 69:15	highest ^[7] - 34:18, 78:7, 78:9, 92:2, 94:25, 95:15, 139:8
Gary's ^[1] - 125:18	Graduate ^[1] - 56:6	guys ^[1] - 125:13	helps ^[2] - 12:5, 154:22	highlights ^[2] - 101:14, 101:16
gasoline ^[7] - 66:14, 66:16, 66:18, 66:19, 118:16, 121:15	graduate ^[1] - 127:13	H	heroin ^[81] - 77:24, 78:4, 78:12, 78:24, 79:1, 79:3, 79:13, 79:15, 79:23, 80:9, 80:10, 81:3, 81:5, 81:9, 81:10, 81:12, 81:13, 82:15, 82:20, 82:25, 83:14, 83:20, 87:16, 88:10, 95:5, 96:19, 98:9, 98:11, 98:12, 99:1, 99:8, 99:24, 99:25, 100:1, 100:2, 100:5, 100:8, 100:10, 100:17, 101:6, 102:12, 109:21, 121:21, 121:22, 132:19, 134:5, 134:19, 135:5, 135:11, 135:15, 135:23, 136:5, 136:18, 136:25, 137:5, 137:8, 137:10, 138:7, 139:1, 139:3, 141:1, 141:4, 142:6, 142:9, 142:11, 142:14, 142:19, 142:22, 142:23, 143:3, 143:4, 144:14, 144:18, 145:7, 146:11, 146:16, 147:1, 147:12, 147:13	history ^[2] - 25:5, 30:12
gateway ^[16] - 136:3, 136:6, 136:8, 136:12, 136:16, 136:17, 136:20, 136:21, 136:23, 142:9, 143:7, 143:14, 143:22, 144:2, 145:8	graph ^[14] - 44:7, 44:8, 81:3, 95:1, 117:25, 132:22, 133:2, 139:7, 139:10, 139:20, 140:8, 140:24, 141:6, 141:7	Hague ^[1] - 30:4	hit ^[1] - 198:22	hold ^[4] - 25:22, 82:5, 105:11, 107:19
gateways ^[2] - 146:1, 146:3	graphic ^[1] - 125:25	half ^[5] - 89:11, 89:13, 93:8, 101:9, 101:10	hold ^[4] - 25:22, 82:5, 105:11, 107:19	home ^[1] - 198:22
gears ^[1] - 103:9	graphs ^[1] - 110:25	hand ^[23] - 24:17, 27:7, 43:24, 48:17, 55:19, 73:5, 88:10, 88:11, 88:19, 89:13, 97:6, 140:12, 150:18, 171:24, 172:2, 173:9, 173:14, 176:3, 176:6, 176:17, 176:18, 183:19, 184:4	home ^[1] - 198:22	honest ^[1] - 138:23
geez ^[3] - 66:11, 76:14, 93:22	great ^[3] - 118:6, 123:6, 123:8	handle ^[1] - 128:14	hinge ^[1] - 177:12	honest ^[1] - 138:23
gender ^[1] - 85:24	greater ^[8] - 48:2, 83:10, 83:11, 89:3, 98:20, 98:21, 111:12	happy ^[1] - 55:10	HIPAA ^[1] - 23:6	honestly ^[1] - 120:14
general ^[17] - 32:22, 63:17, 82:7, 97:13, 97:16, 103:18, 103:22, 117:22, 118:8, 118:23, 119:7, 119:9, 119:14, 126:3, 127:24, 133:14, 139:14	greatest ^[2] - 68:1, 84:17	hard ^[4] - 10:3, 54:19, 62:6, 126:6	hired ^[2] - 54:18, 190:14	Honor ^[72] - 7:12, 7:15, 13:7, 14:10, 20:25, 21:14, 23:17, 23:19, 23:24, 24:7, 36:10, 36:20, 40:23, 47:18, 47:21, 50:23, 51:2, 51:4, 54:24, 55:1, 55:5, 55:10, 55:14, 55:24, 63:11, 81:21, 104:8, 106:17, 116:6, 117:8, 121:3, 127:15, 127:18, 129:14, 129:15, 130:11, 130:16, 131:5, 134:21, 142:2, 145:9, 147:3, 148:2, 148:6, 148:8, 148:22, 148:24, 149:23, 150:1, 150:6, 150:11, 150:23, 150:25, 158:4, 160:12, 160:19, 163:14, 163:19, 164:22, 165:2, 181:18, 181:23, 182:11, 182:16, 182:25,
generally ^[13] - 17:6, 35:7, 44:5, 46:5, 48:22, 50:12, 50:15, 80:20, 119:16, 126:6, 146:20, 179:23, 188:5	green ^[5] - 81:5, 81:10, 95:4, 95:23, 95:25	harder ^[4] - 98:11, 100:9, 102:25, 133:2	history ^[2] - 25:5, 30:12	hit ^[1] - 198:22
Generally ^[1] - 50:14	GRETCHEN ^[1] - 6:7	HARDIN ^[3] - 5:3, 127:18, 129:15	hit ^[1] - 198:22	hold ^[4] - 25:22, 82:5, 105:11, 107:19
generate ^[3] - 126:17, 126:18, 126:20	grew ^[2] - 9:18, 110:20	Hartle ^[2] - 190:18, 191:1	hold ^[4] - 25:22, 82:5, 105:11, 107:19	home ^[1] - 198:22
generated ^[1] - 54:8	grocery ^[1] - 67:9	hat ^[1] - 104:11	home ^[1] - 198:22	honest ^[1] - 138:23
generates ^[3] - 126:18, 126:21, 126:22	gross ^[1] - 77:17	Hawkins ^[1] - 3:7	honest ^[1] - 138:23	honestly ^[1] - 120:14
genesis ^[2] - 18:11, 69:24	grounds ^[2] - 134:20, 189:21	head ^[1] - 127:1	HIPAA ^[1] - 23:6	hired ^[2] - 54:18, 190:14
geographic ^[11] - 38:16, 81:20, 81:23, 92:6, 96:13, 98:23, 101:12, 102:7, 115:20, 196:16, 197:8	group ^[15] - 79:15, 87:11, 92:1, 93:2, 93:7, 93:8, 93:17, 95:11, 105:1, 105:2, 105:3, 105:4, 139:5, 148:18	headquartered ^[1] - 34:4	history ^[2] - 25:5, 30:12	hit ^[1] - 198:22
George ^[3] - 56:4, 57:3, 125:16	group-wise ^[1] - 87:11	Health ^[3] - 4:16, 5:2, 32:3	history ^[2] - 25:5, 30:12	hold ^[4] - 25:22, 82:5, 105:11, 107:19
GEP ^[1] - 57:23	growing ^[1] - 45:6	health ^[9] - 59:16, 59:17, 59:18, 60:3, 60:13, 61:19, 62:12, 63:13, 63:20	history ^[2] - 25:5, 30:12	home ^[1] - 198:22
Given ^[1] - 20:5	grown ^[1] - 35:13	healthcare ^[5] - 60:3, 61:19, 64:6, 64:7, 64:10	history ^[2] - 25:5, 30:12	honest ^[1] - 138:23
	growth ^[13] - 37:19, 45:8, 45:10, 45:11, 45:14, 45:15, 57:24, 59:14, 59:22, 77:25, 78:11, 78:12, 78:13	healthcare-related ^[1] - 61:19	history ^[2] - 25:5, 30:12	honestly ^[1] - 120:14
	Guard ^[8] - 33:18, 33:21, 33:25, 34:8, 34:12, 34:17, 34:24, 35:1	hear ^[2] - 10:17, 21:7	history ^[2] - 25:5, 30:12	Honor ^[72] - 7:12, 7:15, 13:7, 14:10, 20:25, 21:14, 23:17, 23:19, 23:24, 24:7, 36:10, 36:20, 40:23, 47:18, 47:21, 50:23, 51:2, 51:4, 54:24, 55:1, 55:5, 55:10, 55:14, 55:24, 63:11, 81:21, 104:8, 106:17, 116:6, 117:8, 121:3, 127:15, 127:18, 129:14, 129:15, 130:11, 130:16, 131:5, 134:21, 142:2, 145:9, 147:3, 148:2, 148:6, 148:8, 148:22, 148:24, 149:23, 150:1, 150:6, 150:11, 150:23, 150:25, 158:4, 160:12, 160:19, 163:14, 163:19, 164:22, 165:2, 181:18, 181:23, 182:11, 182:16, 182:25,

<p>189:7, 189:20, 191:5, 196:15, 199:11, 199:14, 199:15 HONORABLE [1] - 1:17 Honorable [1] - 7:1 hope [1] - 148:4 hopefully [1] - 74:9 hoping [1] - 119:6 horizontal [5] - 73:1, 88:8, 88:13, 118:17, 138:10 Hospital [3] - 40:5, 186:5, 186:8 hospital [1] - 181:4 hospitals [2] - 40:3, 48:10 huge [2] - 80:14, 124:22 Hughes [5] - 7:6, 7:18, 23:15, 23:20, 23:22 HUGHES [1] - 7:9 hundred [4] - 43:15, 110:5, 113:8, 142:13 Huntington [55] - 3:10, 4:1, 9:16, 9:23, 10:2, 13:6, 13:22, 17:15, 17:24, 21:11, 22:24, 23:12, 37:6, 37:15, 38:9, 38:18, 38:22, 39:21, 40:5, 40:13, 41:9, 41:18, 43:13, 44:12, 44:16, 46:9, 46:19, 49:6, 49:11, 49:16, 50:1, 50:4, 50:9, 52:24, 65:16, 103:12, 103:20, 103:24, 114:23, 141:10, 151:22, 154:20, 155:14, 161:10, 172:6, 175:16, 176:8, 184:6, 185:23, 186:18, 197:14, 198:3, 198:8, 198:9, 201:6 HUNTINGTON [1] - 1:4 Huntington/Cabell [5] - 53:13, 54:2, 192:6, 192:8, 197:8 hydro [2] - 155:2, 184:1 hydrocodone [5] - 183:7, 186:10, 186:20, 196:23, 197:3 hypothetical [1] - 137:3</p>	<p>I</p> <p>idea [5] - 69:17, 125:19, 140:18, 170:16, 193:3 identified [2] - 66:25, 152:6 identify [5] - 19:5, 42:21, 54:15, 164:20, 182:18 identifying [4] - 41:22, 49:4, 164:25, 177:10 ignore [1] - 197:15 illegal [11] - 59:20, 78:3, 96:8, 101:19, 103:3, 122:19, 122:25, 123:2, 124:1, 125:2 illicit [41] - 74:23, 75:16, 78:1, 79:3, 79:5, 79:6, 80:8, 80:9, 80:10, 80:13, 80:16, 80:19, 83:24, 84:1, 84:3, 84:6, 84:15, 85:9, 86:11, 90:21, 93:5, 95:9, 96:5, 98:17, 98:18, 99:16, 99:17, 101:14, 101:16, 101:24, 109:24, 112:21, 121:10, 122:14, 123:19, 123:21, 124:22, 125:6, 139:22, 140:14 Illinois [2] - 63:3, 63:4 illustrate [5] - 116:21, 120:4, 169:20, 171:13, 175:25 illustration [1] - 116:15 illustrations [1] - 59:13 impact [15] - 19:22, 20:24, 21:13, 22:1, 22:19, 53:13, 78:3, 84:12, 154:4, 169:20, 175:11, 175:20, 175:25, 176:4, 178:14 impacts [1] - 171:8 implement [1] - 159:12 implementation [1] - 171:25 implemented [3] - 152:13, 158:16, 170:10 implicitly [1] - 122:19 implied [3] - 104:2,</p>	<p>104:3, 109:3 imply [1] - 113:6 importance [1] - 101:14 important [7] - 76:17, 82:9, 105:19, 108:6, 179:9, 179:15, 179:20 importantly [1] - 123:5 imposed [2] - 18:25, 128:21 imposes [1] - 173:2 impossible [1] - 126:9 improper [1] - 116:5 improve [1] - 24:5 improvements [1] - 59:17 IMS [5] - 12:13, 32:3, 32:7, 32:9 IN [2] - 1:1, 1:18 inaccurate [1] - 21:16 inception [1] - 30:23 include [13] - 26:15, 29:14, 39:24, 40:5, 40:8, 44:24, 48:9, 108:22, 132:18, 162:16, 162:20, 162:22, 186:7 included [3] - 39:19, 41:10, 48:6 includes [7] - 39:20, 41:2, 44:14, 46:21, 75:16, 159:11, 162:21 including [6] - 14:7, 14:24, 58:14, 61:12, 74:22, 170:9 income [1] - 59:15 inconsistency [5] - 154:4, 154:13, 177:19, 178:14, 178:19 inconsistent [3] - 153:5, 154:3, 177:16 inconvenience [1] - 24:2 increase [12] - 7:22, 66:12, 77:21, 80:14, 84:3, 84:6, 86:16, 98:21, 101:15, 121:12, 175:15, 175:17 increased [5] - 70:2, 70:21, 84:5, 87:6, 87:16 increases [1] - 85:9 increasing [4] - 81:13, 81:15, 112:7, 123:7 indeed [3] - 77:19, 88:25, 98:2</p>	<p>independent [3] - 31:4, 39:24, 186:7 indicated [2] - 73:4, 169:22 indicates [1] - 138:16 indirectly [1] - 19:24 individual [3] - 35:2, 35:22, 58:5 individuals [10] - 36:6, 91:20, 93:15, 96:11, 102:5, 134:12, 134:14, 134:15, 145:3 industries [2] - 128:12, 156:15 industry [15] - 8:8, 8:15, 9:1, 9:6, 9:9, 31:25, 35:17, 61:23, 62:13, 64:18, 68:5, 128:11, 156:18, 158:17 ineffective [2] - 123:3, 123:6 inelastic [4] - 121:11, 121:15, 121:19, 121:20 inelasticity [1] - 120:21 infer [3] - 71:14, 105:16, 144:2 inferior [1] - 124:19 inflection [4] - 133:5, 133:18, 133:22, 133:23 influence [3] - 68:2, 74:14, 74:17 influences [1] - 67:18 information [19] - 10:4, 23:7, 27:9, 33:1, 38:10, 54:13, 54:20, 102:1, 154:17, 162:16, 179:10, 179:20, 180:4, 180:10, 180:15, 180:25, 181:9, 183:15, 195:5 informative [1] - 180:15 ingested [1] - 141:4 initial [1] - 165:19 initiate [3] - 135:4, 142:22, 143:3 initiated [2] - 19:1, 142:14 initiating [1] - 135:15 initiation [1] - 134:19 innovation [1] - 64:8 input [7] - 74:9, 107:6, 107:7, 107:8, 107:9, 107:11, 163:20</p>	<p>inputted [1] - 159:7 inquired [1] - 23:10 inside [1] - 74:17 insights [1] - 58:4 instance [5] - 120:23, 126:9, 164:10, 168:23, 170:25 instances [1] - 31:19 instead [6] - 113:14, 114:12, 126:24, 126:25, 169:1, 175:6 instructor [1] - 32:19 intellectual [1] - 32:5 intend [1] - 158:25 intending [2] - 148:20, 159:19 interest [1] - 69:5 interested [1] - 108:15 interestingly [1] - 97:18 internal [1] - 26:12 interpret [1] - 197:18 interpretation [1] - 187:25 interrupted [1] - 199:25 intersect [2] - 119:18, 119:20 intervening [1] - 120:1 intervention [1] - 120:2 interventions [1] - 119:23 introduce [3] - 24:24, 56:2, 151:5 introduced [5] - 8:4, 117:19, 135:10, 158:14, 184:25 introducing [1] - 74:24 invalid [1] - 152:24 investigate [1] - 153:23 investigator [1] - 188:9 invokes [1] - 70:8 invoking [1] - 189:1 involve [2] - 162:1, 181:4 involved [11] - 15:16, 27:5, 27:6, 28:19, 29:1, 31:18, 35:16, 61:11, 62:11, 137:19, 157:6 involves [1] - 155:21 involving [5] - 29:10, 31:8, 31:25, 44:21, 156:18 IQVIA [1] - 12:14 Iran [2] - 29:24, 30:8</p>
--	---	---	--	--

<p>Iranian [1] - 30:4 Irpino [1] - 3:7 ISIA [1] - 5:4 Islamic [1] - 30:8 issue [4] - 81:7, 91:3, 100:5, 103:15 issued [1] - 9:12 issues [6] - 14:11, 27:7, 82:2, 102:21, 125:19, 163:5 it'll [1] - 79:22 item [8] - 38:12, 38:14, 41:20, 42:22, 43:6, 49:2, 54:16 itself [4] - 162:4, 162:13, 189:14, 189:23</p>	<p>Judicial [2] - 32:17 Judiciary [1] - 33:8 July [6] - 7:4, 28:18, 168:10, 168:11, 201:9, 201:15 JULY [1] - 1:19 jump [1] - 125:24 June [1] - 168:5 Justice [2] - 63:9, 156:1 justification [1] - 122:13</p>	<p>134:8, 134:9, 197:10 known [1] - 24:1 KOUBA [1] - 4:11</p>	<p>lectured [1] - 157:15 ledgers [1] - 54:14 Lee [1] - 3:12 leeway [1] - 182:2 left [21] - 73:5, 88:10, 88:19, 89:7, 95:10, 95:16, 95:22, 97:6, 97:8, 102:23, 138:8, 171:24, 172:2, 173:15, 174:2, 174:17, 176:3, 176:6, 177:2, 178:6, 183:19 left-hand [8] - 88:10, 88:19, 97:6, 171:24, 172:2, 176:3, 176:6, 183:19 legal [10] - 16:5, 16:10, 16:14, 19:2, 64:16, 67:7, 90:16, 122:18, 128:24, 164:24 legalize [1] - 123:18 legalized [1] - 125:11 legalizing [2] - 122:14, 125:6 legitimate [9] - 22:8, 22:14, 22:18, 67:7, 68:13, 147:14, 175:15, 175:16, 182:6 length [1] - 148:14 Leon [2] - 2:4, 2:14 less [23] - 79:23, 79:25, 89:14, 101:7, 102:25, 110:22, 119:15, 120:10, 120:13, 121:11, 121:12, 121:16, 122:21, 125:8, 132:25, 142:20, 142:21, 143:8, 143:20, 145:19, 147:13, 184:1, 195:24 lessened [1] - 17:19 lesson [1] - 117:20 lethal [3] - 77:25, 79:16, 79:20 lethality [1] - 110:3 level [28] - 58:5, 65:22, 66:8, 66:9, 67:25, 68:8, 68:15, 68:16, 73:4, 77:17, 78:8, 78:9, 82:7, 84:17, 84:25, 90:1, 92:13, 92:15, 94:17, 101:10, 103:18, 103:22, 110:25, 111:21, 136:23,</p>	<p>154:24, 155:1, 197:2 levels [4] - 85:16, 92:4, 93:20, 95:1 levers [1] - 68:8 Levin [1] - 2:10 LEYIMU [1] - 4:13 liability [1] - 31:12 licensed [4] - 14:8, 14:25, 15:20, 25:21 licenses [1] - 25:23 licit [2] - 74:23, 140:14 lies [1] - 67:17 Lieutenant [1] - 33:17 likely [7] - 99:20, 137:6, 137:8, 140:12, 140:16, 165:13, 184:8 limit [4] - 40:9, 129:5, 129:6, 190:22 limited [6] - 20:24, 21:13, 22:1, 116:18, 161:16, 164:19 limits [2] - 18:10, 129:20 LINDA [1] - 4:8 line [68] - 37:13, 37:14, 38:12, 44:8, 44:13, 44:18, 44:20, 44:21, 45:8, 45:14, 45:22, 45:23, 49:6, 49:7, 49:9, 49:14, 52:23, 53:9, 53:19, 73:1, 73:6, 73:19, 74:19, 75:15, 78:24, 78:25, 79:8, 79:9, 79:23, 80:14, 81:5, 81:6, 81:10, 81:12, 82:15, 82:16, 94:13, 94:16, 94:18, 94:19, 94:20, 95:3, 95:24, 95:25, 97:1, 97:8, 97:11, 100:22, 100:24, 100:25, 118:23, 121:1, 132:4, 132:15, 132:16, 133:12, 133:25, 134:1, 134:2, 173:1, 191:7 lines [6] - 53:20, 72:25, 73:3, 95:5, 95:23, 100:21 link [5] - 77:4, 85:7, 86:3, 90:19, 124:15 linking [1] - 86:4 liquid [13] - 41:3, 43:5, 43:7, 43:10, 44:9, 44:25, 45:1, 46:21, 48:7, 48:8, 48:10, 50:3 Lisa [2] - 6:18, 201:3</p>
<p>J</p>	<p>K</p>	<p>L</p>		
<p>Jackson [1] - 6:8 JAMES [1] - 7:9 James [1] - 187:22 January [1] - 168:4 JASIEWICZ [1] - 5:4 JEFFREY [1] - 5:13 JENNIFER [1] - 4:18 Jersey [5] - 25:2, 33:17, 33:25, 34:5, 34:17 jives [1] - 39:3 job [1] - 35:9 jobs [1] - 35:9 John [1] - 60:7 join [1] - 127:18 joined [2] - 25:15, 156:7 JOSEPH [1] - 6:4 Journal [4] - 59:4, 59:5, 123:16, 124:5 journals [2] - 59:3, 59:6 JR [2] - 2:3, 2:12 Juan [2] - 2:5, 2:14 judge [8] - 70:4, 106:7, 115:22, 117:10, 118:8, 130:14, 141:18, 158:8 Judge [14] - 7:2, 21:6, 34:25, 36:14, 40:17, 47:9, 55:4, 160:6, 165:1, 165:8, 182:8, 187:17, 191:9, 199:7 JUDGE [1] - 1:17 judges [9] - 30:3, 30:4, 30:5, 32:13, 32:22, 33:5, 33:9, 33:10 judgment [1] - 116:25</p>	<p>Kansas [1] - 34:20 KEARSE [2] - 4:2, 23:17 keep [2] - 66:8, 82:9 Kelly [1] - 6:8 Kenneth [1] - 60:12 Kessler [1] - 4:23 Kevin [4] - 55:6, 55:15, 55:17, 56:4 KEVIN [1] - 55:20 key [1] - 116:20 Keyes [13] - 80:21, 84:19, 103:10, 103:11, 103:18, 103:23, 107:14, 108:5, 108:18, 109:12, 109:15, 111:22, 112:13 Keyes' [4] - 104:23, 106:3, 114:18, 115:14 kids [1] - 117:25 kilograms [1] - 195:13 kind [42] - 11:11, 22:25, 35:17, 58:1, 65:18, 67:19, 69:19, 69:23, 74:17, 75:10, 82:24, 88:23, 91:18, 94:10, 94:25, 95:7, 96:2, 96:24, 99:5, 101:1, 101:2, 101:20, 102:22, 104:25, 107:2, 109:1, 110:6, 113:15, 119:16, 123:10, 123:20, 125:1, 132:9, 133:8, 133:21, 134:1, 143:11, 144:10, 145:23, 164:15, 180:22 kinds [4] - 61:14, 63:7, 118:19, 121:20 knowledge [7] - 15:9, 16:16, 20:18, 126:2,</p>	<p>LA [1] - 3:8 labor [2] - 57:13, 61:18 Labor [1] - 60:21 laced [1] - 137:10 lack [5] - 20:25, 124:21, 132:6, 153:18, 174:11 lacking [1] - 153:1 laid [3] - 181:19, 181:22, 183:14 laissez [1] - 119:19 language [1] - 188:12 Lanier [1] - 3:4 large [19] - 7:22, 26:13, 27:13, 27:15, 28:19, 30:14, 31:9, 31:18, 50:17, 123:22, 154:19, 156:21, 156:25, 158:5, 160:14, 160:17, 180:13, 184:13, 184:15 largely [1] - 38:2 largest [3] - 30:11, 31:14, 31:15 Last [1] - 197:6 last [14] - 13:16, 34:8, 73:15, 116:3, 129:1, 139:12, 148:10, 154:15, 156:8, 184:24, 193:7, 193:8, 198:21 late [1] - 84:15 late-year [1] - 84:15 latest [1] - 99:11 latitude [2] - 14:15, 189:11 Laughter [1] - 150:4 LAURA [1] - 5:10 law [3] - 119:17, 120:9, 149:1 Law [3] - 3:4, 3:7, 3:12 laws [3] - 15:19, 16:4, 16:7 lead [2] - 29:25, 115:6 leading [3] - 35:23, 59:3, 141:1 leads [1] - 121:12 league [1] - 198:22 least [1] - 123:16 Leavenworth [1] - 34:20 lecture [1] - 146:23</p>		

<p>list [3] - 11:11, 148:21, 167:6</p> <p>literal [1] - 187:25</p> <p>literature [6] - 18:22, 99:23, 134:10, 134:14, 134:17, 135:9</p> <p>litigation [11] - 8:11, 11:9, 29:10, 31:13, 61:12, 62:2, 155:23, 157:19, 157:25, 158:2, 180:24</p> <p>Litigation [1] - 30:21</p> <p>litigations [2] - 30:14, 30:16</p> <p>LLC [1] - 2:4</p> <p>located [1] - 32:17</p> <p>locations [1] - 72:6</p> <p>Logan [3] - 6:5, 6:12, 194:13</p> <p>logical [1] - 98:7</p> <p>longevity [2] - 59:18, 60:4</p> <p>look [55] - 12:22, 15:7, 73:11, 74:19, 76:2, 77:13, 83:8, 83:17, 84:11, 85:12, 85:23, 85:24, 86:6, 87:19, 88:9, 91:2, 91:4, 93:6, 94:6, 95:4, 97:18, 98:22, 101:23, 102:3, 105:23, 111:11, 113:18, 121:9, 121:23, 122:1, 122:3, 124:15, 129:21, 134:14, 134:23, 135:3, 135:4, 146:20, 146:22, 149:21, 151:12, 155:13, 155:14, 159:2, 159:9, 160:9, 162:10, 179:15, 180:25, 190:9, 190:23, 193:4, 194:9</p> <p>looked [25] - 10:3, 20:20, 45:3, 48:6, 78:5, 82:13, 84:7, 92:20, 93:19, 99:22, 109:23, 110:25, 112:21, 134:13, 153:9, 153:10, 156:18, 162:2, 162:3, 180:14, 182:22, 190:25, 191:20, 192:2, 198:23</p> <p>looking [31] - 23:2, 30:17, 41:19, 44:5,</p>	<p>45:13, 45:22, 65:22, 68:25, 85:19, 86:3, 86:4, 87:19, 88:10, 88:11, 93:21, 94:5, 94:22, 95:8, 102:12, 105:2, 122:8, 134:11, 135:13, 139:20, 142:15, 144:7, 150:3, 156:17, 159:10, 159:25, 199:3</p> <p>looks [6] - 78:22, 99:5, 121:6, 168:3, 175:1, 193:6</p> <p>Los [1] - 56:10</p> <p>Louis [1] - 36:4</p> <p>low [2] - 122:2, 155:1</p> <p>lower [3] - 100:7, 120:10</p> <p>Luis [1] - 34:12</p> <p>lunch [3] - 130:1, 130:3, 130:15</p> <p>Lybrand [5] - 25:15, 26:3, 27:25, 28:2, 33:22</p>	<p>Mainigi [1] - 149:16</p> <p>MAJESTRO [11] - 2:6, 7:15, 7:17, 13:14, 13:19, 14:18, 14:19, 21:3, 21:20, 21:23, 24:4</p> <p>Majestro [4] - 2:6, 7:13, 13:13, 14:17</p> <p>major [1] - 198:22</p> <p>majority [1] - 169:16</p> <p>makeup [1] - 35:7</p> <p>males [1] - 91:11</p> <p>malpractice [1] - 31:15</p> <p>management [1] - 156:20</p> <p>mandatory [1] - 28:11</p> <p>manner [1] - 35:10</p> <p>manual [1] - 188:14</p> <p>manufacturers [4] - 31:2, 65:5, 128:9, 128:14</p> <p>manufacturing [1] - 156:19</p> <p>March [1] - 168:4</p> <p>margin [1] - 147:16</p> <p>marijuana [1] - 125:11</p> <p>mark [1] - 147:8</p> <p>MARK [1] - 3:14</p> <p>market [24] - 58:10, 63:24, 65:24, 66:3, 67:2, 74:1, 98:17, 98:18, 99:16, 99:17, 101:14, 101:16, 101:24, 119:20, 123:23, 124:17, 140:7, 155:13, 155:15, 184:25, 185:2, 185:12, 185:20, 186:18</p> <p>marketplace [6] - 66:1, 67:8, 73:21, 75:13, 124:20, 132:10</p> <p>markets [15] - 9:2, 57:12, 57:13, 58:2, 58:5, 58:9, 59:20, 60:3, 64:6, 64:7, 64:10, 119:5, 124:22, 127:14</p> <p>MARTENS [1] - 24:18</p> <p>Martens [26] - 24:10, 24:15, 24:22, 24:24, 25:1, 25:3, 25:16, 32:6, 34:21, 34:24, 35:5, 36:11, 37:2, 37:23, 40:21, 41:19, 44:4, 45:25, 46:5, 47:23, 48:18, 48:21, 49:21, 51:6, 51:11,</p>	<p>55:2</p> <p>Mary's [1] - 40:6</p> <p>Master [2] - 30:21</p> <p>Master's [1] - 36:2</p> <p>Masters [9] - 187:25, 188:6, 188:7, 188:9, 188:12, 188:14, 188:18, 188:22, 193:3</p> <p>match [2] - 41:25, 53:7</p> <p>matched [1] - 41:24</p> <p>materials [11] - 23:3, 23:5, 33:3, 64:12, 64:21, 166:8, 166:14, 182:13, 185:5, 191:8, 191:22</p> <p>math [4] - 52:12, 52:13, 53:10, 106:25</p> <p>mathematics [3] - 105:1, 106:24, 133:22</p> <p>matrix [1] - 192:5</p> <p>matter [21] - 30:10, 30:20, 30:22, 31:14, 32:5, 34:22, 35:4, 35:21, 36:7, 63:16, 64:11, 72:16, 74:3, 116:16, 116:19, 120:25, 130:18, 164:18, 165:19, 201:5</p> <p>matters [20] - 27:8, 28:19, 28:21, 29:9, 29:21, 29:23, 31:1, 31:8, 31:15, 31:17, 31:22, 61:12, 61:13, 61:14, 61:25, 62:12, 156:16, 156:18, 157:23, 181:4</p> <p>maximizing [1] - 68:24</p> <p>maximum [10] - 167:10, 168:5, 168:8, 168:15, 168:25, 174:19, 175:2, 193:7, 193:8, 193:16</p> <p>MBA [2] - 25:9, 25:10</p> <p>McCann [67] - 39:6, 39:9, 39:11, 39:12, 42:8, 52:9, 151:13, 151:20, 152:13, 152:16, 152:18, 153:3, 153:20, 154:11, 154:19, 159:7, 159:9, 161:2, 161:7, 161:8, 161:13, 161:16, 162:2, 162:9,</p>	<p>162:16, 163:21, 164:13, 164:17, 164:19, 165:4, 165:23, 166:6, 166:13, 169:1, 169:9, 169:14, 170:9, 170:12, 170:19, 170:23, 171:3, 172:13, 172:16, 172:22, 174:3, 175:8, 176:5, 176:20, 178:8, 178:11, 178:20, 180:3, 180:14, 184:13, 184:17, 185:7, 186:3, 186:6, 186:24, 188:17, 188:24, 188:25, 194:3, 194:17, 198:16, 199:2</p> <p>McCann's [73] - 38:3, 51:22, 52:12, 52:13, 153:12, 154:6, 155:3, 155:14, 159:1, 159:2, 159:16, 159:20, 159:25, 160:25, 161:2, 161:23, 161:25, 162:5, 162:7, 162:12, 166:1, 166:9, 166:10, 166:15, 167:19, 167:22, 168:3, 168:22, 169:24, 170:2, 171:4, 171:14, 171:25, 172:3, 172:4, 172:10, 172:25, 173:13, 173:18, 173:23, 174:5, 174:9, 174:24, 175:25, 176:7, 176:10, 176:23, 177:16, 177:20, 178:1, 178:15, 180:9, 180:20, 181:9, 182:1, 182:19, 183:17, 184:5, 184:12, 186:1, 186:18, 190:10, 190:23, 191:20, 192:1, 192:13, 192:17, 193:6, 194:16, 194:18, 198:1, 199:3</p> <p>MCCLURE [1] - 6:3</p> <p>MCGINNESS [1] - 4:2</p> <p>McKesson [21] - 5:8, 155:10, 161:12, 163:11, 163:18,</p>
--	--	---	--	---

<p>164:6, 164:10, 164:11, 167:15, 169:18, 170:25, 185:9, 185:22, 186:4, 190:14, 190:19, 191:23, 194:1, 194:5, 194:21, 194:23</p> <p>McKesson's [11] - 155:13, 184:25, 185:2, 185:12, 185:19, 186:10, 186:20, 191:2, 191:17, 191:21</p> <p>mean [38] - 34:5, 70:22, 73:23, 82:7, 83:11, 94:9, 112:18, 116:6, 116:16, 119:10, 119:11, 120:8, 120:9, 122:22, 123:2, 124:13, 125:8, 125:16, 126:5, 127:7, 128:7, 133:7, 135:25, 136:6, 136:8, 136:13, 136:16, 136:17, 136:20, 140:3, 141:3, 143:7, 143:10, 143:14, 143:15, 188:16, 188:24</p> <p>meaningful [1] - 69:12</p> <p>means [13] - 72:2, 72:5, 89:12, 108:13, 121:11, 121:12, 131:18, 133:23, 143:21, 154:13, 164:21, 169:25, 177:14</p> <p>measure [13] - 17:18, 66:6, 73:13, 73:25, 87:20, 87:23, 90:9, 132:8, 132:10, 197:22</p> <p>measured [5] - 74:21, 131:19, 131:24, 132:11, 132:13</p> <p>measurement [1] - 132:6</p> <p>measuring [3] - 73:2, 97:7, 97:9</p> <p>mechanical [1] - 6:19</p> <p>medal [1] - 60:7</p> <p>Medal [1] - 34:19</p> <p>Medicaid [2] - 18:22, 20:6</p> <p>Medical [2] - 185:23, 186:12</p> <p>medical [5] - 22:9,</p>	<p>22:10, 22:14, 22:18, 135:9</p> <p>Medicare [1] - 181:5</p> <p>Medicare/Medicaid [1] - 181:3</p> <p>medication [4] - 41:21, 41:22, 47:8, 48:3</p> <p>medications [22] - 37:15, 37:17, 37:18, 41:10, 41:11, 41:14, 42:11, 42:13, 42:15, 46:8, 47:1, 47:3, 48:2, 48:6, 48:9, 48:14, 49:10, 50:11, 50:18</p> <p>meet [2] - 51:16, 141:23</p> <p>member [7] - 26:5, 26:11, 32:16, 32:19, 60:19, 60:20, 60:21</p> <p>members [2] - 30:2, 34:13</p> <p>men [3] - 91:8, 91:10, 91:13</p> <p>mentioned [10] - 61:7, 67:16, 90:14, 96:13, 144:17, 149:16, 152:16, 153:16, 154:2, 199:16</p> <p>mentors [1] - 57:5</p> <p>merge [1] - 27:25</p> <p>merged [1] - 28:2</p> <p>merger [1] - 156:25</p> <p>Meritorious [1] - 34:18</p> <p>mess [2] - 107:22, 139:13</p> <p>messed [1] - 113:16</p> <p>met [2] - 15:11, 187:13</p> <p>Method [42] - 154:7, 154:8, 167:9, 167:14, 167:22, 168:3, 168:20, 169:9, 169:12, 171:6, 171:25, 172:4, 172:17, 173:5, 173:13, 173:23, 174:5, 174:7, 174:9, 174:17, 174:18, 174:23, 174:25, 175:3, 175:4, 175:12, 175:14, 175:20, 176:1, 176:7, 176:15, 176:23, 177:5, 177:8, 178:1, 178:6, 178:9, 183:17, 184:5, 188:16</p> <p>method [1] - 177:9</p>	<p>methodological [1] - 115:1</p> <p>methodologies [28] - 151:18, 151:20, 152:6, 152:11, 152:12, 152:19, 152:22, 152:23, 153:6, 153:19, 154:5, 154:16, 159:5, 159:7, 160:25, 165:18, 165:24, 166:2, 166:7, 166:11, 166:20, 167:1, 186:2, 186:3, 187:16, 187:21</p> <p>methodology [17] - 82:17, 103:10, 104:23, 104:25, 106:5, 108:1, 108:2, 111:24, 112:12, 112:16, 113:24, 115:10, 123:12, 159:22, 189:2, 191:2, 193:3</p> <p>Methodology [5] - 167:19, 187:24, 190:13, 191:2, 191:4</p> <p>methods [3] - 171:21, 178:17, 178:21</p> <p>Methods [5] - 167:3, 167:6, 167:7, 177:20</p> <p>Mexico [1] - 100:1</p> <p>mic [1] - 12:4</p> <p>MICHAEL [2] - 2:12, 3:9</p> <p>Michigan [1] - 156:5</p> <p>micro [1] - 58:15</p> <p>microeconomics [7] - 57:12, 57:16, 57:19, 57:21, 58:1, 60:1, 64:4</p> <p>middle [2] - 91:20, 148:15</p> <p>middle-age [1] - 91:20</p> <p>might [19] - 16:6, 16:7, 65:21, 68:2, 69:18, 71:16, 119:24, 121:18, 122:18, 142:22, 149:8, 150:2, 162:22, 162:23, 178:23, 179:18, 180:15, 181:2</p> <p>MILDRED [1] - 3:3</p> <p>military [3] - 30:1, 33:14, 34:1</p> <p>mill [2] - 20:18, 20:19</p> <p>milligram [1] - 131:23</p> <p>million [8] - 13:5,</p>	<p>13:21, 23:10, 53:10, 53:12, 53:16, 105:5, 105:6</p> <p>Milton [2] - 57:3, 125:13</p> <p>mind [6] - 30:10, 30:20, 42:14, 44:1, 66:8, 82:9</p> <p>mine [2] - 122:7, 125:18</p> <p>Mingo [3] - 196:10, 196:12, 196:22</p> <p>minimum [1] - 62:23</p> <p>Minneapolis [1] - 30:15</p> <p>minute [8] - 40:15, 77:16, 104:5, 111:20, 117:11, 147:6, 196:13</p> <p>minutes [3] - 28:22, 117:13, 130:6</p> <p>mis [1] - 110:9</p> <p>mis-calibrated [1] - 110:9</p> <p>misinterpretation [1] - 71:18</p> <p>missed [2] - 110:6, 147:19</p> <p>Mississippi [11] - 97:4, 97:5, 97:7, 97:10, 100:18, 111:2, 111:7, 137:5, 137:9, 137:12</p> <p>misstates [1] - 147:3</p> <p>misuse [3] - 134:18, 142:9, 144:13</p> <p>misused [2] - 133:22, 136:7</p> <p>misuses [2] - 144:1</p> <p>misusing [1] - 142:7</p> <p>Mitchell [1] - 2:10</p> <p>mix [3] - 37:16, 46:10, 100:9</p> <p>mixed [1] - 79:15</p> <p>MME [6] - 73:8, 88:6, 97:7, 122:9, 131:14, 131:17</p> <p>MMEs [5] - 73:5, 121:25, 122:6, 122:9</p> <p>modal [1] - 94:17</p> <p>mode [2] - 95:13, 95:14</p> <p>model [5] - 116:17, 123:17, 125:25, 176:16</p> <p>modeling [4] - 124:7, 124:12, 152:18, 157:13</p> <p>models [3] - 128:17, 153:17, 157:8</p>	<p>molecular [1] - 146:11</p> <p>molecule [2] - 146:11, 146:12</p> <p>moment [4] - 77:24, 78:10, 136:24, 141:18</p> <p>moments [1] - 165:22</p> <p>monitor [1] - 15:25</p> <p>Monitoring [2] - 158:17, 198:17</p> <p>month [16] - 167:10, 168:2, 168:9, 168:13, 172:9, 174:18, 193:15, 193:18, 193:23, 193:24, 194:10, 194:14, 194:22, 194:24, 196:23</p> <p>monthly [4] - 167:10, 172:9, 174:19, 193:16</p> <p>months [10] - 168:4, 168:6, 168:16, 168:25, 175:2, 192:20, 193:7, 193:9, 193:16, 193:24</p> <p>morality [2] - 83:22, 85:15</p> <p>morning [18] - 7:5, 7:11, 7:12, 24:7, 24:8, 24:22, 24:23, 51:15, 51:17, 55:23, 55:24, 56:2, 150:23, 151:7, 199:19, 199:21, 199:23, 200:6</p> <p>morphine [5] - 131:19, 131:22, 131:25, 132:1, 146:12</p> <p>Morris [1] - 6:15</p> <p>mortalities [1] - 78:4</p> <p>mortality [117] - 69:11, 70:1, 70:3, 70:20, 70:21, 72:13, 74:21, 74:22, 74:25, 75:9, 75:15, 75:17, 75:18, 76:6, 76:14, 76:21, 77:2, 77:15, 77:19, 77:22, 78:11, 78:13, 78:14, 78:23, 80:3, 80:4, 80:8, 80:25, 82:1, 82:19, 82:20, 83:18, 84:6, 84:13, 84:15, 84:16, 85:9, 85:20, 85:21, 86:21, 86:23, 87:16, 87:23, 88:1, 88:9, 88:10, 88:11, 88:16, 89:11, 90:1, 91:16, 91:19,</p>
--	---	--	--	---

<p>91:21, 91:24, 92:3, 92:10, 92:14, 92:21, 93:1, 94:1, 94:2, 95:17, 95:18, 96:14, 96:19, 96:20, 97:1, 97:18, 97:21, 97:23, 97:24, 98:1, 98:3, 98:21, 98:25, 99:5, 99:8, 99:13, 100:17, 101:6, 101:15, 104:1, 105:3, 105:14, 105:17, 105:21, 106:1, 107:20, 108:4, 108:9, 108:14, 108:17, 109:16, 109:18, 109:19, 109:25, 110:1, 110:5, 110:12, 110:17, 110:21, 111:1, 111:22, 112:2, 112:21, 114:1, 114:2, 114:4, 114:11, 115:2, 115:4, 117:4, 138:7, 138:8, 139:1, 139:3, 139:8</p> <p>most [15] - 33:4, 57:2, 59:22, 79:5, 80:18, 92:2, 98:7, 128:17, 132:10, 134:22, 135:3, 155:21, 155:24, 158:2, 196:8</p> <p>mostly [2] - 80:16, 100:2</p> <p>motivated [3] - 18:5, 22:17, 22:18</p> <p>Motley [5] - 4:3, 4:5, 4:8, 4:11, 4:14</p> <p>MOUGEY [1] - 2:9</p> <p>mouthful [1] - 174:21</p> <p>move [12] - 34:6, 36:24, 45:25, 47:14, 49:19, 50:23, 66:17, 70:4, 71:9, 142:18, 143:7, 143:19</p> <p>moved [2] - 90:21, 149:4</p> <p>moves [2] - 145:19, 193:23</p> <p>moving [7] - 34:2, 95:21, 96:12, 125:11, 134:15, 148:12, 149:3</p> <p>MR [156] - 2:3, 2:6, 2:9, 2:12, 3:9, 3:11, 3:14, 4:5, 4:22, 5:9, 5:10, 5:13, 6:4, 7:15, 7:17, 13:7, 13:14, 13:19, 14:10, 14:18,</p>	<p>14:19, 20:25, 21:3, 21:14, 21:20, 21:23, 23:19, 24:4, 24:7, 24:9, 24:13, 24:21, 35:3, 36:10, 36:14, 36:20, 36:24, 37:1, 40:16, 40:17, 40:23, 41:1, 43:24, 44:3, 46:3, 46:4, 47:9, 47:13, 47:18, 47:21, 47:22, 48:17, 48:20, 50:23, 51:2, 51:4, 51:5, 51:10, 51:14, 52:20, 52:22, 54:24, 55:1, 55:5, 55:8, 55:14, 56:1, 57:8, 57:10, 63:11, 63:15, 63:22, 70:4, 70:16, 72:19, 72:21, 81:20, 81:22, 92:5, 92:8, 104:8, 104:15, 104:18, 104:21, 106:7, 106:17, 106:20, 115:22, 115:25, 116:3, 116:6, 116:10, 117:7, 117:10, 117:16, 117:18, 118:1, 118:4, 120:3, 121:3, 121:7, 127:15, 127:20, 127:23, 129:14, 129:18, 130:1, 130:3, 130:7, 130:11, 130:14, 130:16, 130:20, 130:24, 131:7, 131:10, 134:20, 138:2, 138:3, 141:18, 141:21, 142:1, 142:4, 145:9, 146:4, 146:7, 146:9, 147:3, 147:8, 147:9, 147:17, 148:2, 158:8, 158:10, 158:13, 160:3, 160:6, 163:14, 164:22, 181:18, 182:8, 182:25, 187:12, 187:15, 187:19, 189:13, 189:20, 190:2, 191:9, 191:13, 191:15, 192:19, 192:22, 196:21, 199:6, 199:11</p> <p>MS [76] - 3:3, 3:6, 4:2, 4:8, 4:11, 4:13, 4:17, 4:18, 4:20, 5:3, 5:4, 5:10, 6:3, 6:7, 6:14, 23:17, 127:18,</p>	<p>129:15, 148:8, 149:19, 149:23, 150:1, 150:5, 150:11, 150:25, 151:2, 151:4, 152:1, 152:5, 155:6, 155:8, 158:4, 160:12, 160:19, 160:22, 160:23, 163:19, 164:1, 164:2, 165:2, 165:8, 165:16, 166:16, 166:18, 167:14, 167:17, 170:5, 170:7, 171:16, 171:18, 174:14, 174:16, 177:22, 177:24, 179:1, 179:3, 181:11, 181:13, 181:23, 182:11, 182:16, 182:17, 183:5, 184:21, 184:23, 185:15, 185:17, 186:25, 189:7, 191:5, 196:15, 199:9, 199:15, 199:22, 200:2, 200:11</p> <p>Mt [3] - 4:4, 4:12, 4:15</p> <p>Mulligan [1] - 122:8</p> <p>multiple [4] - 109:25, 144:25, 145:2, 157:5</p> <p>multiplied [1] - 42:21</p> <p>multiplier [1] - 114:13</p> <p>multiply [1] - 105:6</p> <p>Murphy [62] - 55:6, 55:15, 55:17, 56:2, 56:4, 56:8, 56:23, 57:9, 57:19, 58:19, 60:5, 61:7, 63:12, 63:23, 67:16, 70:13, 70:19, 71:1, 72:11, 72:22, 74:20, 76:19, 78:17, 80:24, 81:23, 82:6, 82:12, 83:12, 84:4, 88:3, 92:9, 94:6, 98:14, 98:24, 100:14, 101:13, 102:14, 103:9, 104:8, 104:10, 104:22, 106:19, 106:21, 107:24, 108:1, 111:20, 116:7, 116:11, 117:7, 123:14, 130:5, 130:17, 130:22, 131:2, 131:4, 131:11, 142:5, 143:24, 146:4, 146:10,</p>	<p>148:1, 148:3</p> <p>MURPHY [1] - 55:20</p> <p>must [1] - 153:22</p> <hr/> <p>N</p> <hr/> <p>name [9] - 24:14, 35:24, 51:15, 55:16, 56:4, 117:19, 150:15, 151:7, 158:14</p> <p>names [1] - 38:10</p> <p>Nate [2] - 190:18, 191:1</p> <p>National [9] - 32:16, 32:17, 33:18, 33:21, 33:25, 34:11, 34:17, 61:1, 61:4</p> <p>national [10] - 38:13, 92:13, 100:21, 102:14, 102:15, 110:18, 111:13, 111:15, 114:7, 157:1</p> <p>nationally [2] - 101:9, 112:21</p> <p>nationwide [1] - 92:10</p> <p>natural [1] - 119:20</p> <p>nature [13] - 38:15, 42:16, 98:8, 98:17, 99:16, 99:23, 115:20, 120:21, 125:2, 161:6, 163:21, 163:22, 165:4</p> <p>NBER [1] - 61:4</p> <p>NDC [3] - 38:13, 41:23, 41:24</p> <p>necessary [1] - 17:12</p> <p>need [21] - 14:20, 65:11, 67:12, 76:7, 76:10, 76:11, 76:12, 76:13, 107:12, 107:16, 108:12, 108:16, 111:12, 111:13, 113:10, 114:1, 114:2, 114:4, 136:7, 150:9, 164:3</p> <p>needs [1] - 175:6</p> <p>negative [1] - 76:1</p> <p>net [2] - 30:17, 112:4</p> <p>Netherlands [1] - 30:4</p> <p>Nevada [1] - 32:18</p> <p>never [6] - 8:25, 9:16, 11:8, 117:21, 189:9, 192:11</p> <p>New [9] - 3:5, 3:8, 25:2, 25:21, 27:1, 33:17, 33:25, 34:4, 34:17</p> <p>new [2] - 74:24,</p>	<p>149:22</p> <p>newly [2] - 34:8, 34:9</p> <p>news [2] - 149:15, 150:2</p> <p>next [23] - 24:10, 34:14, 45:25, 49:19, 55:6, 55:15, 78:15, 80:24, 82:4, 90:13, 100:13, 120:3, 130:5, 139:11, 148:15, 148:17, 149:6, 149:13, 168:13, 192:19, 193:23, 194:7, 194:8</p> <p>nice [2] - 82:4, 104:18</p> <p>NICHOLAS [2] - 6:11, 21:14</p> <p>nine [1] - 30:3</p> <p>Ninth [1] - 4:9</p> <p>Nobel [1] - 57:2</p> <p>non [29] - 21:21, 30:1, 31:2, 37:14, 37:17, 41:11, 41:14, 41:21, 42:10, 42:13, 42:18, 43:10, 44:11, 44:24, 45:10, 45:14, 46:12, 47:3, 47:7, 48:2, 49:24, 50:11, 50:18, 109:10, 110:1, 113:4, 113:7, 121:14, 125:25</p> <p>non-addictive [1] - 121:14</p> <p>non-control [1] - 21:21</p> <p>non-fentanyl [3] - 110:1, 113:4, 113:7</p> <p>non-graphic [1] - 125:25</p> <p>non-military [1] - 30:1</p> <p>non-opioid [18] - 37:14, 37:17, 41:11, 41:14, 41:21, 42:10, 42:13, 44:11, 45:10, 45:14, 46:12, 47:3, 47:7, 48:2, 49:24, 50:11, 50:18, 109:10</p> <p>non-opioids [3] - 42:18, 43:10, 44:24</p> <p>non-participating [1] - 31:2</p> <p>None [1] - 9:3</p> <p>none [2] - 89:12, 200:9</p> <p>nonprescription [1] - 93:18</p> <p>note [2] - 83:3, 189:20</p> <p>noted [1] - 125:5</p> <p>notes [1] - 160:9</p> <p>Nothing [3] - 24:3,</p>
---	---	---	---	--

<p>29:2, 199:9 nothing [5] - 29:2, 70:24, 87:2, 146:3, 182:25 notice [1] - 148:19 notion [1] - 69:8 notions [2] - 72:8, 89:4 nowhere [3] - 16:19, 196:1, 196:3 number [72] - 7:19, 7:25, 32:3, 46:1, 57:2, 58:21, 59:2, 59:10, 60:14, 61:16, 61:20, 61:24, 62:8, 62:11, 73:24, 78:18, 83:16, 89:9, 91:6, 103:25, 105:9, 105:23, 107:18, 108:3, 108:7, 108:11, 108:13, 108:19, 108:23, 111:6, 111:11, 111:14, 111:15, 112:5, 112:8, 112:9, 113:6, 113:9, 113:10, 113:19, 113:21, 113:22, 114:6, 114:7, 114:9, 114:11, 114:12, 114:13, 114:15, 114:16, 114:21, 115:6, 115:8, 115:11, 115:13, 115:17, 117:20, 136:18, 137:22, 138:14, 139:4, 171:17, 175:23, 177:23, 180:18, 181:12, 184:18, 185:16, 186:24, 195:12, 198:21 numbers [12] - 38:13, 47:24, 50:22, 53:8, 88:21, 94:24, 108:5, 111:22, 116:24, 154:9, 168:1, 179:13 numerator [2] - 111:9, 115:1 NW [6] - 4:6, 4:9, 4:19, 4:21, 5:5, 5:12 NY [1] - 3:5</p>	<p>127:15, 129:14, 134:20, 160:4, 189:21, 196:16 objection [22] - 13:7, 14:16, 36:13, 36:15, 40:18, 47:16, 51:2, 63:14, 70:10, 70:12, 106:8, 106:15, 129:17, 134:25, 145:9, 158:7, 163:14, 164:22, 165:7, 181:18, 189:7, 196:17 objections [1] - 51:1 obligated [1] - 195:22 obligation [2] - 180:18, 182:20 obligations [1] - 154:25 observation [1] - 45:4 observations [2] - 45:2, 47:24 observe [4] - 85:9, 92:1, 143:24, 145:1 observed [1] - 72:1 obtained [3] - 152:15, 159:13, 160:1 obtaining [1] - 25:10 obviously [6] - 63:19, 75:18, 77:17, 84:14, 107:19, 149:17 occasion [1] - 78:2 occasionally [1] - 157:21 occasions [1] - 30:13 occurred [1] - 181:20 occurring [1] - 84:17 occurs [1] - 163:4 OF [2] - 1:1, 1:4 offer [4] - 11:4, 51:6, 158:25, 159:14 offered [5] - 32:21, 33:7, 128:23, 154:15, 179:5 offering [7] - 12:5, 13:10, 15:10, 16:3, 37:2, 159:22, 163:17 office [1] - 27:1 officer [2] - 33:18, 34:2 Official [2] - 201:2, 201:3 often [6] - 128:15, 144:8, 146:2, 155:24, 179:11, 179:13 oil [2] - 66:15 older [10] - 91:6, 91:7, 91:8, 91:13, 91:15, 91:21, 91:22, 92:25,</p>	<p>95:20 once [14] - 35:1, 38:8, 46:7, 68:14, 157:24, 166:19, 169:2, 173:18, 175:3, 175:8, 189:15, 190:6, 193:19 Once [1] - 41:15 one [101] - 15:17, 16:2, 25:14, 30:11, 31:14, 44:13, 45:4, 45:9, 48:5, 51:18, 57:5, 58:13, 60:25, 62:23, 63:25, 65:21, 72:9, 75:4, 75:24, 75:25, 76:4, 77:5, 79:12, 79:18, 79:24, 79:25, 84:14, 85:23, 88:3, 88:24, 89:7, 91:6, 92:13, 93:21, 96:12, 98:7, 100:15, 102:1, 102:18, 102:20, 109:19, 110:6, 110:9, 110:18, 111:8, 113:17, 114:16, 115:19, 116:13, 117:21, 118:2, 118:3, 122:1, 122:12, 129:1, 130:16, 133:12, 133:13, 135:7, 139:12, 142:1, 143:8, 144:1, 144:7, 144:9, 145:16, 145:19, 145:21, 145:22, 145:23, 150:6, 153:1, 154:11, 154:12, 155:24, 162:24, 164:23, 174:11, 179:11, 184:14, 192:20, 194:8, 195:21, 195:22, 196:7, 196:23, 197:23, 198:21, 199:2 One [1] - 5:11 ones [6] - 42:14, 60:22, 78:20, 140:23, 149:22, 165:13 open [1] - 22:3 operate [3] - 58:6, 164:7, 166:11 operated [2] - 163:12, 163:22 operates [2] - 167:19, 174:24 operation [1] - 61:11 operations [1] - 34:15</p>	<p>opiate [1] - 13:5 opine [2] - 16:20, 163:22 opining [1] - 18:1 opinion [24] - 12:12, 84:25, 106:4, 107:13, 123:9, 128:23, 139:19, 153:17, 159:15, 159:22, 162:12, 164:18, 165:6, 171:4, 174:9, 177:8, 177:17, 179:5, 181:22, 182:4, 182:6, 183:3, 194:25, 195:1 opinions [21] - 11:4, 12:5, 12:19, 13:10, 15:11, 16:3, 30:6, 36:25, 37:2, 37:7, 37:9, 37:12, 37:13, 38:1, 38:17, 38:20, 51:6, 151:16, 155:17, 158:25, 163:17 opioid [101] - 7:19, 9:22, 10:15, 10:22, 11:9, 16:12, 16:21, 17:20, 18:15, 20:4, 20:10, 22:24, 23:10, 37:14, 37:17, 37:18, 37:22, 41:10, 41:11, 41:14, 41:20, 41:21, 41:22, 42:1, 42:4, 42:10, 42:13, 42:24, 44:10, 44:11, 45:10, 45:11, 45:14, 45:15, 45:18, 46:12, 46:13, 47:1, 47:3, 47:7, 48:2, 48:3, 49:15, 49:24, 50:6, 50:10, 50:11, 50:18, 50:19, 69:11, 70:1, 70:20, 72:13, 74:22, 74:25, 75:15, 75:18, 76:15, 76:20, 77:15, 77:21, 78:1, 78:4, 79:8, 79:9, 80:3, 80:4, 80:25, 81:25, 83:18, 84:5, 84:6, 84:12, 84:22, 85:9, 94:8, 94:20, 96:13, 96:19, 98:25, 99:5, 109:10, 112:21, 126:3, 126:4, 126:5, 126:15, 132:12, 132:16, 132:20, 132:25, 134:18, 138:13, 140:1, 142:9, 180:24</p>	<p>opioid-related [1] - 72:13 opioids [116] - 9:2, 10:9, 10:12, 11:6, 14:5, 14:22, 15:2, 15:15, 16:8, 20:23, 21:12, 42:18, 42:21, 43:10, 44:24, 47:7, 52:23, 64:14, 65:8, 65:12, 65:15, 66:23, 66:24, 67:13, 68:6, 68:10, 68:12, 69:1, 69:5, 69:10, 69:17, 69:20, 69:21, 70:1, 70:20, 72:12, 73:24, 74:23, 75:16, 75:20, 77:1, 77:18, 78:3, 78:24, 79:3, 79:14, 84:12, 85:8, 86:1, 86:2, 86:11, 87:16, 90:15, 90:16, 90:21, 90:22, 91:1, 93:5, 93:18, 96:5, 96:6, 96:8, 96:9, 99:1, 102:10, 102:11, 103:3, 109:11, 109:24, 126:1, 126:10, 129:11, 132:18, 132:24, 133:15, 134:4, 135:6, 135:12, 135:16, 135:23, 136:4, 136:19, 136:25, 137:22, 137:23, 139:22, 141:4, 141:9, 142:7, 142:12, 142:19, 142:20, 142:21, 143:2, 144:14, 144:18, 144:23, 145:6, 146:10, 146:16, 147:1, 147:12, 147:15, 163:13, 164:8, 183:25, 185:3, 185:23, 186:4, 194:22, 195:4, 197:17 opium [3] - 120:24, 121:22, 140:14 opportunity [1] - 32:12 opposed [4] - 18:16, 111:14, 172:23, 177:4 opposition [1] - 125:6 orange [5] - 46:13, 49:7, 49:14, 53:19, 53:20 orangish [1] - 100:24</p>
O				
<p>obeys [2] - 120:9 Obispo [1] - 34:12 object [12] - 13:11, 14:10, 20:25, 21:14, 21:16, 121:3,</p>				

Order [2] - 158:16, 198:17 order [17] - 43:18, 67:6, 68:21, 69:3, 110:16, 128:2, 163:5, 163:20, 164:19, 165:23, 170:17, 170:25, 175:24, 185:5, 189:15, 190:6 ordered [1] - 34:13 orders [35] - 68:19, 69:7, 129:12, 162:17, 162:20, 162:22, 162:23, 162:25, 163:2, 163:4, 163:8, 163:13, 164:8, 164:9, 164:11, 164:15, 164:16, 164:20, 164:25, 165:11, 165:12, 167:23, 168:19, 168:20, 171:1, 171:5, 174:10, 177:10, 189:1, 189:5, 191:18, 197:11, 197:12, 197:21 organizations [1] - 60:16 orient [1] - 151:16 orientation [1] - 131:12 originally [1] - 141:11 Orleans [1] - 3:8 ostensibly [1] - 153:7 otherwise [1] - 129:4 OD [26] - 103:10, 103:11, 103:19, 103:23, 104:3, 107:15, 108:2, 108:15, 108:17, 108:20, 108:22, 109:7, 109:10, 109:11, 109:13, 110:15, 111:17, 111:23, 112:5, 114:5, 114:14, 114:19, 114:22, 115:8, 115:13, 115:20 outcome [13] - 65:25, 66:10, 69:24, 73:11, 73:12, 73:13, 74:1, 74:4, 87:8, 87:9, 87:22, 90:2 outcomes [2] - 84:23, 86:25 outlets [1] - 65:6	outline [2] - 24:5, 82:5 outpacing [2] - 45:10, 45:14 output [9] - 65:22, 66:9, 66:12, 107:6, 107:8, 107:10, 107:11, 116:20 outset [1] - 179:4 outside [10] - 8:11, 10:23, 20:14, 20:17, 68:14, 71:16, 128:24, 161:18, 163:15, 180:23 Outside [1] - 8:16 outstanding [2] - 60:9, 60:13 overall [3] - 37:21, 45:5, 113:9 overdose [7] - 69:20, 77:6, 93:20, 94:23, 104:1, 108:21, 109:11 overdosed [3] - 102:10, 109:8, 109:9 overdoses [8] - 69:18, 95:6, 102:12, 109:6, 109:13, 137:11, 137:23, 140:1 overdosing [4] - 90:16, 96:4, 96:5, 140:14 overestimating [1] - 112:1 overlap [3] - 53:3, 81:7, 83:5 overlaps [1] - 83:4 overly [1] - 122:15 override [5] - 14:16, 70:11, 106:14, 134:25, 165:6 Overruled [2] - 182:14, 191:14 overruled [6] - 13:17, 21:2, 116:8, 145:13, 163:24, 189:25 oversee [1] - 36:5 oversight [1] - 119:19 overstates [1] - 111:24 oversupply [1] - 65:15 overview [1] - 155:17 overwhelming [1] - 90:11 overwhelmingly [2] - 67:14, 83:20 own [4] - 13:2, 14:1, 166:12, 191:17 oxy [2] - 155:2, 183:25 oxycodone [4] - 183:8, 186:10,	186:20, 197:3 P P-1200 [1] - 2:7 p.m [3] - 130:23, 187:7, 200:12 P.O [2] - 5:14, 6:8 PA [3] - 6:6, 6:13, 6:15 page [3] - 138:6, 169:18, 169:19 Page [5] - 139:11, 152:2, 166:17, 167:15, 174:15 paid [5] - 9:5, 9:8, 20:10, 20:23, 21:12 pain [2] - 10:16, 10:20 panel [5] - 88:10, 88:11, 88:19, 89:13, 97:6 Papantonio [1] - 2:10 paper [3] - 60:13, 112:20 papers [11] - 58:21, 58:23, 103:14, 106:4, 120:16, 120:21, 122:13, 124:6, 134:13, 166:4 Paragraph [1] - 159:14 paragraph [1] - 159:21 parallel [2] - 132:25, 133:2 paraphrasing [1] - 140:3 pardon [1] - 158:9 parked [1] - 70:9 part [25] - 8:2, 13:16, 14:6, 14:23, 15:14, 28:19, 30:14, 30:23, 33:13, 51:23, 58:15, 61:10, 64:3, 71:5, 71:7, 72:15, 110:22, 128:15, 147:19, 154:25, 188:18, 189:2, 191:12 participants [2] - 14:7, 14:24 participating [1] - 31:2 particular [21] - 58:8, 61:14, 66:22, 66:24, 68:11, 77:25, 83:21, 96:14, 96:19, 116:22, 132:11, 133:10, 137:7, 145:5, 153:10, 159:22, 168:1, 169:4, 181:6, 192:24, 196:7	particularity [1] - 99:18 particularly [7] - 60:2, 76:12, 84:16, 91:22, 93:6, 98:18, 137:11 partner [11] - 24:10, 26:9, 26:17, 26:22, 28:4, 28:13, 28:16, 29:3, 29:5, 31:3, 33:21 partner-type [1] - 28:16 parts [5] - 58:17, 86:8, 98:9, 99:25 party [1] - 11:1 pass [1] - 117:8 passed [1] - 125:17 past [4] - 11:12, 33:10, 126:14, 126:19 patent [1] - 61:18 pathway [1] - 143:5 patient [9] - 11:3, 23:6, 67:23, 67:24, 67:25, 68:1, 74:9, 126:24, 127:3 patients [8] - 10:15, 67:21, 68:2, 74:7, 74:10, 127:6, 127:24, 140:12 patients' [1] - 10:20 pattern [9] - 82:24, 88:24, 97:13, 97:16, 197:15, 197:16, 198:11, 198:15, 198:24 patterns [4] - 59:15, 82:5, 92:17, 145:1 PAUL [2] - 2:3, 5:9 Paul [6] - 30:15, 40:24, 51:15, 117:19, 158:15, 187:13 pause [2] - 73:17, 84:10 Pause [2] - 130:13, 141:20 pay [2] - 22:19, 125:3 payer [5] - 10:22, 11:1, 18:5, 21:24, 22:19 Payer [3] - 20:23, 21:9, 21:12 payers [24] - 7:18, 10:1, 10:7, 10:8, 10:11, 10:19, 11:7, 13:8, 15:14, 15:20, 15:24, 16:3, 16:7, 16:12, 16:16, 17:16, 17:19, 18:19, 19:12, 21:18, 22:23, 23:10, 74:14	Payers [3] - 15:14, 19:22, 23:6 payers' [3] - 8:4, 16:20, 18:1 paying [3] - 7:18, 22:1, 22:13 payment [2] - 10:12, 64:8 payments [2] - 20:12, 20:16 peak [5] - 45:18, 83:13, 83:15, 94:18, 95:2 peaked [1] - 45:20 peaking [1] - 83:1 peaks [2] - 73:9, 81:15 PEARL [1] - 3:6 pedigree [1] - 51:18 peer [1] - 8:25 peer-reviewed [1] - 8:25 pending [2] - 30:14, 31:16 Pensacola [1] - 2:11 people [95] - 23:13, 35:10, 35:12, 35:24, 57:3, 57:23, 66:14, 66:16, 66:17, 71:13, 74:22, 74:23, 76:23, 79:13, 79:24, 85:25, 86:4, 90:19, 91:12, 91:15, 91:21, 91:23, 92:25, 93:3, 93:17, 94:10, 95:19, 99:22, 99:23, 102:9, 105:5, 108:22, 109:2, 109:3, 109:10, 118:18, 119:14, 122:5, 123:9, 123:22, 123:24, 124:18, 124:24, 125:10, 125:18, 125:21, 134:4, 134:7, 135:4, 135:15, 135:23, 136:18, 136:24, 139:17, 139:20, 139:21, 139:22, 139:24, 139:25, 140:5, 140:19, 140:22, 140:25, 141:2, 141:5, 141:11, 141:16, 142:6, 142:10, 142:11, 142:13, 142:18, 142:22, 142:23, 143:2, 143:4, 143:6, 143:11, 143:12, 143:16, 143:19,
---	---	---	---	--

<p>144:7, 144:13, 144:22, 145:1, 145:5, 145:16, 145:18, 145:21, 147:15, 194:21</p> <p>Pepsi [10] - 143:9, 143:12, 143:13, 143:14, 143:16, 143:17, 144:11, 145:24, 147:23, 147:24</p> <p>per [22] - 31:5, 35:8, 66:6, 73:5, 73:8, 74:21, 78:22, 87:21, 88:7, 97:7, 97:8, 98:16, 122:9, 131:15, 131:17, 131:19, 132:13, 148:20</p> <p>percent [58] - 19:25, 20:4, 20:22, 21:11, 21:21, 22:13, 46:24, 47:3, 50:5, 50:8, 89:11, 89:13, 89:14, 91:8, 91:9, 91:11, 91:12, 91:13, 91:14, 105:6, 109:4, 110:5, 113:8, 121:12, 121:13, 142:13, 154:7, 154:8, 155:1, 172:19, 172:20, 173:19, 174:1, 174:4, 176:11, 176:12, 176:19, 177:1, 178:8, 178:12, 183:10, 184:1, 184:2, 184:7, 186:15, 186:23, 195:4, 195:6, 196:24, 197:4, 199:4</p> <p>percentage [20] - 20:9, 20:16, 46:12, 46:13, 47:7, 50:16, 92:2, 154:20, 173:23, 176:23, 180:13, 181:20, 183:7, 183:20, 183:24, 184:1, 186:9, 186:14, 186:22</p> <p>percentages [1] - 49:23</p> <p>Perfect [1] - 193:19</p> <p>perform [7] - 17:1, 17:9, 37:4, 54:3, 54:4, 155:9, 155:12</p> <p>performed [11] - 17:17, 34:20, 36:6, 36:7, 53:5, 53:14, 53:18, 53:22, 53:24,</p>	<p>84:4, 151:13</p> <p>perhaps [3] - 70:8, 148:24, 149:1</p> <p>period [104] - 8:3, 9:22, 18:14, 28:14, 28:20, 37:6, 38:25, 39:2, 39:3, 39:4, 39:5, 44:7, 45:6, 46:8, 48:4, 49:12, 49:16, 50:1, 50:13, 73:14, 74:25, 75:8, 76:3, 76:4, 76:12, 76:13, 76:14, 76:18, 76:19, 77:1, 77:2, 77:13, 77:22, 78:11, 79:5, 79:10, 80:14, 80:16, 80:18, 80:23, 84:15, 84:18, 84:20, 84:21, 84:23, 85:14, 85:15, 85:25, 86:2, 86:7, 86:21, 86:22, 86:23, 86:24, 87:3, 87:4, 87:24, 87:25, 88:1, 88:15, 88:17, 89:16, 89:19, 90:1, 90:2, 90:6, 90:7, 90:20, 90:22, 91:5, 91:17, 91:23, 92:3, 93:16, 94:3, 94:4, 94:20, 94:22, 94:24, 95:18, 96:5, 96:6, 98:5, 98:21, 99:11, 100:20, 101:15, 101:23, 102:11, 102:12, 102:24, 109:24, 113:2, 132:23, 133:1, 133:8, 135:13, 135:19, 139:5, 139:21, 139:22, 175:10, 193:4</p> <p>periods [6] - 75:5, 75:12, 75:14, 76:3, 76:11, 93:9</p> <p>permitted [1] - 189:12</p> <p>person [2] - 112:25, 121:22</p> <p>personal [2] - 23:7, 134:8</p> <p>perspective [10] - 64:19, 64:22, 69:12, 71:1, 116:11, 135:21, 177:11, 178:16, 178:23, 184:10</p> <p>pertain [1] - 82:2</p> <p>Peter [2] - 150:16, 151:7</p> <p>PETER [2] - 2:9, 150:19</p>	<p>petroleum [1] - 118:21</p> <p>Petters [1] - 30:10</p> <p>Ph.D [7] - 36:2, 56:11, 56:16, 57:17, 60:2, 156:4, 156:6</p> <p>pharmaceutical [15] - 8:8, 8:11, 8:15, 9:1, 31:25, 32:4, 61:23, 61:24, 62:12, 156:18, 156:19, 158:17, 161:9, 181:4</p> <p>Pharmaceutical [3] - 187:25, 188:14, 188:22</p> <p>pharmaceuticals [2] - 65:5, 158:21</p> <p>pharmacies [25] - 20:18, 38:21, 39:24, 40:1, 40:9, 48:10, 65:6, 65:11, 68:24, 127:3, 127:25, 128:5, 128:8, 128:13, 128:16, 128:22, 151:21, 157:1, 157:4, 161:9, 186:7, 192:5, 192:8, 192:18, 194:16</p> <p>Pharmacy [4] - 14:9, 14:25, 15:22, 21:10</p> <p>pharmacy [23] - 20:21, 20:24, 21:10, 21:13, 21:24, 22:13, 38:10, 68:14, 68:17, 68:19, 68:20, 68:21, 69:6, 126:25, 127:6, 156:20, 167:25, 169:3, 192:15, 192:16, 194:13, 196:23</p> <p>Philadelphia [2] - 6:6, 6:13</p> <p>phonetic [1] - 112:23</p> <p>phrase [1] - 71:25</p> <p>physician [3] - 22:6, 22:15, 22:17</p> <p>physicians [1] - 22:5</p> <p>pick [1] - 39:2</p> <p>picture [6] - 40:10, 41:16, 88:23, 88:24, 121:6, 172:3</p> <p>piece [1] - 173:3</p> <p>pieces [1] - 101:25</p> <p>Pierce [2] - 43:24, 48:17</p> <p>PIFKO [1] - 3:14</p> <p>piling [1] - 69:6</p> <p>pill [4] - 20:18, 20:19, 50:5, 50:8</p> <p>pills [25] - 7:25, 13:5, 13:22, 17:14, 22:24,</p>	<p>23:11, 49:3, 53:16, 54:1, 54:9, 76:23, 127:6, 128:5, 139:17, 139:18, 140:5, 140:11, 140:13, 140:17, 140:25, 141:3, 141:14, 194:14, 197:7</p> <p>Pittsburgh [1] - 9:18</p> <p>place [4] - 77:6, 79:18, 79:19, 106:7</p> <p>places [6] - 54:2, 68:19, 86:20, 87:24, 87:25, 110:22</p> <p>plaintiff [1] - 9:14</p> <p>Plaintiff [5] - 1:5, 1:11, 2:2, 3:2, 4:1</p> <p>Plaintiffs [1] - 201:6</p> <p>plaintiffs [4] - 47:10, 148:16, 148:19, 148:24</p> <p>plaintiffs' [4] - 9:13, 39:6, 84:19, 142:24</p> <p>play [2] - 64:23, 68:1</p> <p>played [1] - 101:17</p> <p>plays [2] - 67:23, 99:11</p> <p>Pleasant [3] - 4:4, 4:12, 4:15</p> <p>pleasure [2] - 141:23, 148:5</p> <p>plot [1] - 88:5</p> <p>plots [1] - 88:3</p> <p>plugged [1] - 113:21</p> <p>point [51] - 25:22, 26:17, 26:24, 27:25, 28:7, 48:5, 64:15, 65:23, 65:24, 67:19, 73:3, 73:18, 75:3, 75:21, 78:2, 86:14, 93:19, 95:15, 96:7, 98:23, 102:8, 102:13, 102:16, 104:4, 108:1, 108:25, 110:24, 112:10, 124:7, 128:19, 130:10, 130:11, 133:5, 133:8, 133:18, 133:19, 133:24, 135:22, 138:12, 138:17, 142:1, 143:19, 143:24, 144:12, 144:20, 145:25, 168:18, 191:12</p> <p>points [5] - 50:16, 87:13, 119:6, 122:12, 131:12</p>	<p>policies [5] - 190:5, 190:11, 194:1, 194:3, 194:4</p> <p>policy [2] - 57:14, 188:14</p> <p>political [1] - 125:6</p> <p>Political [1] - 59:4</p> <p>Ponc [1] - 2:4</p> <p>Ponce [1] - 2:14</p> <p>ponzi [1] - 30:11</p> <p>population [53] - 23:12, 53:17, 88:20, 90:15, 94:11, 96:11, 103:12, 104:2, 104:3, 105:3, 105:5, 105:9, 105:15, 105:16, 105:17, 105:18, 105:20, 105:22, 105:24, 105:25, 106:2, 107:15, 107:17, 107:19, 108:2, 108:8, 108:10, 108:14, 108:16, 108:17, 108:20, 108:24, 109:3, 109:5, 109:20, 110:12, 110:15, 110:17, 111:17, 111:23, 111:25, 112:1, 112:3, 112:6, 114:2, 114:3, 114:19, 114:22, 115:9, 117:5, 125:3, 134:6</p> <p>populations [2] - 107:3, 113:15</p> <p>portion [2] - 158:1, 172:14</p> <p>position [2] - 140:2, 140:20</p> <p>positions [1] - 34:5</p> <p>positive [1] - 76:1</p> <p>possibility [3] - 140:7, 140:9, 143:1</p> <p>possible [3] - 19:16, 117:10, 150:7</p> <p>post [1] - 85:25</p> <p>post-2010 [2] - 18:13, 77:13</p> <p>post-2011 [1] - 100:19</p> <p>post-2016-2017 [1] - 18:13</p> <p>post-period [1] - 85:25</p> <p>potential [1] - 16:21</p> <p>potentially [1] - 125:20</p> <p>powder [4] - 98:12, 100:2, 100:4, 100:8</p>
---	--	--	---	--

<p>Powell [2] - 2:6, 112:24</p> <p>power [1] - 171:13</p> <p>PR [2] - 2:5, 2:14</p> <p>practice [1] - 27:1</p> <p>pre-2010 [4] - 76:18, 76:19, 87:19, 97:19</p> <p>pre-2011 [1] - 85:6</p> <p>precipitous [1] - 73:10</p> <p>precluding [1] - 29:19</p> <p>predecessor [1] - 25:14</p> <p>predicate [1] - 104:24</p> <p>predict [1] - 87:10</p> <p>predominant [1] - 95:9</p> <p>predominantly [2] - 22:1, 95:10</p> <p>prefer [1] - 55:9</p> <p>preliminary [1] - 106:8</p> <p>preparation [1] - 32:23</p> <p>prepare [4] - 33:3, 48:13, 171:11, 175:19</p> <p>prepared [12] - 27:9, 43:20, 46:1, 72:15, 171:12, 175:24, 177:18, 181:7, 181:15, 185:7, 185:11, 185:18</p> <p>preparing [2] - 11:15, 32:25</p> <p>prescribe [1] - 11:6</p> <p>prescribed [1] - 90:15</p> <p>prescribing [10] - 17:20, 65:9, 65:10, 67:3, 74:17, 84:21, 86:9, 87:7, 87:9, 87:10</p> <p>prescription [106] - 9:1, 10:2, 20:22, 21:11, 22:7, 45:18, 64:13, 65:12, 65:15, 66:23, 67:6, 67:7, 67:8, 67:12, 67:23, 68:6, 68:8, 68:11, 68:12, 69:4, 69:21, 72:12, 74:8, 75:16, 75:20, 76:15, 76:20, 77:14, 77:18, 78:23, 79:4, 79:8, 79:9, 79:14, 79:25, 80:4, 80:12, 82:15, 82:18, 84:2, 84:5, 84:12, 84:22, 85:8, 86:1, 87:15, 92:22, 94:20, 94:23, 96:6, 96:8, 99:1, 99:5, 101:19, 102:18, 103:3,</p>	<p>128:3, 132:12, 132:18, 132:24, 133:15, 134:4, 134:18, 135:6, 135:12, 135:16, 135:23, 136:4, 136:19, 136:25, 137:22, 138:13, 140:6, 140:11, 141:3, 141:9, 141:12, 142:7, 142:9, 142:12, 142:19, 142:20, 142:21, 143:2, 144:14, 144:18, 144:23, 145:6, 146:10, 146:16, 147:1, 147:12, 147:15, 157:4, 163:13, 164:8, 185:3, 185:23, 186:4, 194:22, 195:4, 197:17</p> <p>prescriptions [57] - 7:19, 7:23, 12:7, 20:1, 20:4, 20:10, 22:4, 22:9, 22:12, 22:15, 65:11, 67:1, 67:15, 67:17, 67:19, 68:18, 69:2, 69:6, 69:8, 74:14, 76:25, 77:1, 77:9, 77:10, 77:12, 86:23, 90:20, 90:25, 91:4, 91:6, 91:8, 91:9, 91:11, 91:15, 91:23, 92:2, 92:12, 92:25, 93:4, 93:18, 93:22, 93:23, 94:5, 96:3, 102:10, 127:25, 129:23, 139:21, 139:25, 140:12, 140:22, 140:23, 141:1, 141:15, 141:16</p> <p>present [5] - 83:18, 131:23, 152:19, 164:14, 179:14</p> <p>presentation [4] - 167:18, 171:20, 171:25, 185:19</p> <p>presentations [1] - 157:16</p> <p>presented [13] - 141:11, 152:11, 152:22, 154:2, 163:21, 165:18, 166:21, 173:8, 174:23, 176:22, 177:19, 178:4, 187:21</p>	<p>presenting [1] - 177:25</p> <p>presents [1] - 176:6</p> <p>preserve [1] - 36:14</p> <p>pressure [1] - 42:15</p> <p>presumably [4] - 22:3, 22:6, 76:24, 77:9</p> <p>presume [1] - 109:9</p> <p>pretty [16] - 10:6, 57:1, 58:21, 59:11, 59:22, 63:25, 71:12, 73:10, 81:13, 81:16, 96:4, 96:20, 106:24, 124:10, 127:20, 169:23</p> <p>prevalence [2] - 103:19, 103:23</p> <p>prevalent [1] - 42:12</p> <p>prevent [2] - 12:6, 163:5</p> <p>preventing [1] - 18:6</p> <p>previous [2] - 81:3, 139:21</p> <p>previously [11] - 62:1, 62:15, 62:18, 62:24, 135:5, 135:11, 135:16, 136:18, 142:11, 142:14, 157:20</p> <p>Prevoznik's [1] - 189:22</p> <p>price [14] - 60:1, 119:9, 119:11, 119:13, 119:15, 119:21, 120:10, 120:11, 120:25, 121:12, 122:2, 122:9, 122:10, 129:8</p> <p>Price [1] - 28:2</p> <p>prices [1] - 66:15</p> <p>PricewaterhouseCoopers [3] - 28:3, 28:5, 28:8</p> <p>pricing [1] - 54:7</p> <p>primarily [2] - 18:5, 67:19</p> <p>primary [2] - 77:11, 100:1</p> <p>principles [2] - 32:22, 155:22</p> <p>prison [1] - 124:24</p> <p>private [1] - 63:6</p> <p>privy [2] - 11:1, 15:16</p> <p>prize [1] - 60:12</p> <p>Prize [1] - 57:2</p> <p>probabilities [1] - 142:15</p> <p>probability [1] - 135:8</p> <p>problem [6] - 22:23, 107:23, 123:18,</p>	<p>124:23, 142:17, 142:23</p> <p>problems [1] - 61:23</p> <p>proceed [5] - 7:14, 150:25, 160:20, 160:21, 163:25</p> <p>proceedings [2] - 31:7, 201:5</p> <p>Proceedings [2] - 6:19, 187:7</p> <p>PROCEEDINGS [1] - 7:1</p> <p>proceeds [1] - 168:13</p> <p>process [4] - 74:18, 78:5, 130:25, 192:10</p> <p>processed [5] - 42:8, 51:22, 52:9, 52:14, 52:15</p> <p>processing [1] - 31:21</p> <p>Proctor [1] - 2:10</p> <p>produce [1] - 107:9</p> <p>produced [5] - 6:19, 11:22, 12:1, 57:2, 177:17</p> <p>producer's [1] - 65:23</p> <p>produces [1] - 107:8</p> <p>product [6] - 58:13, 68:17, 118:13, 118:14, 125:2</p> <p>products [11] - 41:3, 43:17, 44:14, 45:15, 46:8, 50:3, 50:6, 50:8, 50:10, 58:17, 124:18</p> <p>professional [5] - 25:4, 51:7, 59:3, 63:23, 116:11</p> <p>Professor [1] - 56:5</p> <p>professor [2] - 56:13, 106:10</p> <p>proffer [1] - 40:17</p> <p>proffered [2] - 63:16, 81:21</p> <p>profit [1] - 68:24</p> <p>program [9] - 32:20, 32:21, 33:2, 33:4, 33:6, 33:7, 33:11, 57:18</p> <p>programs [6] - 163:12, 163:22, 164:7, 165:4, 191:21, 192:3</p> <p>Programs [1] - 198:18</p> <p>prohibition [3] - 122:22, 122:23, 124:17</p> <p>prohibitions [2] - 123:2, 123:3</p> <p>promise [1] - 118:5</p> <p>prone [1] - 144:22</p> <p>propensity [3] - 144:8,</p>	<p>145:16, 145:21</p> <p>proper [2] - 109:19, 189:8</p> <p>property [1] - 32:5</p> <p>proportion [1] - 172:16</p> <p>proposal [1] - 148:25</p> <p>propose [1] - 148:22</p> <p>proposed [1] - 149:16</p> <p>protected [1] - 23:7</p> <p>provide [6] - 27:9, 109:12, 153:3, 170:12, 178:21, 182:2</p> <p>provided [10] - 23:3, 32:24, 53:25, 152:3, 155:16, 162:3, 172:2, 173:14, 174:3, 183:19</p> <p>providers [1] - 58:13</p> <p>provides [4] - 153:22, 154:11, 167:24, 170:19</p> <p>providing [4] - 30:6, 38:20, 163:19, 165:3</p> <p>public [4] - 25:16, 25:19, 57:14, 180:19</p> <p>publicly [2] - 26:6, 183:6</p> <p>publish [3] - 58:20, 195:11, 195:13</p> <p>publishable [1] - 9:4</p> <p>published [12] - 8:25, 58:21, 58:25, 59:2, 59:4, 59:24, 59:25, 120:16, 123:16, 157:12, 183:11, 188:1</p> <p>pull [2] - 46:3, 48:19</p> <p>pulling [2] - 44:1, 54:16</p> <p>purchase [1] - 65:4</p> <p>purports [1] - 103:19</p> <p>purpose [6] - 22:14, 22:16, 22:18, 132:22, 139:16, 198:25</p> <p>purposes [6] - 44:23, 85:11, 106:11, 164:12, 165:10, 165:24</p> <p>pursuant [2] - 69:1, 129:23</p> <p>push [1] - 111:25</p> <p>pushes [1] - 96:10</p> <p>pushing [1] - 112:3</p> <p>put [42] - 71:17, 72:19, 72:22, 78:16, 79:15, 79:18, 79:21, 80:25, 81:8, 88:2, 96:22,</p>
--	--	--	--	--

96:25, 97:2, 100:13, 104:6, 104:10, 107:1, 109:1, 112:11, 113:18, 114:12, 118:1, 124:25, 126:24, 126:25, 135:21, 138:14, 139:23, 141:7, 152:1, 157:8, 162:9, 166:16, 167:15, 171:16, 174:14, 175:22, 177:22, 181:11, 185:15, 190:3, 199:19 putting [3] - 79:2, 129:7, 152:2 PwC [9] - 24:10, 25:1, 25:14, 28:15, 28:23, 29:5, 31:20, 33:22, 35:5	141:21, 142:5, 143:23, 146:5, 158:15, 169:7, 179:12, 187:1, 187:14, 193:1, 199:6 quick [1] - 125:24 quickly [3] - 148:12, 149:3, 149:4 quite [5] - 13:10, 79:4, 88:21, 156:17, 175:13	91:19, 99:1, 108:14, 115:4, 123:21 rather [12] - 94:5, 100:8, 111:7, 113:3, 113:19, 113:25, 122:18, 123:17, 150:24, 176:19, 182:4, 189:1 re [11] - 54:3, 54:4, 79:22, 82:16, 105:14, 105:16, 130:9, 141:25, 173:3, 173:5, 176:16 re-direct [2] - 130:9, 141:25 re-done [2] - 79:22, 82:16 re-perform [2] - 54:3, 54:4 re-run [3] - 173:3, 173:5, 176:16 re-write [1] - 105:14 re-written [1] - 105:16 reach [4] - 107:13, 108:4, 108:18, 193:19 reached [5] - 37:9, 39:15, 78:7, 78:9, 84:25 read [8] - 47:6, 47:11, 47:23, 84:18, 124:5, 140:24, 160:10, 190:17 reading [3] - 50:22, 101:8, 134:10 ready [2] - 106:13, 150:8 real [8] - 125:24, 154:17, 179:7, 179:10, 179:24, 180:4, 180:9, 182:19 reality [1] - 143:1 realize [1] - 123:10 really [6] - 7:21, 29:2, 35:23, 57:15, 58:2, 60:1, 66:9, 68:7, 68:8, 69:22, 71:5, 75:1, 75:12, 76:2, 77:11, 78:11, 78:12, 81:13, 81:15, 83:2, 84:19, 85:2, 85:3, 85:4, 86:4, 87:8, 88:16, 88:18, 90:10, 93:11, 96:11, 99:10, 99:11, 99:15, 100:18, 101:2, 101:16, 101:23, 105:8, 116:20, 117:4, 124:14, 125:3, 128:14,	133:24, 135:3, 147:14, 152:24, 153:22, 154:13, 164:21, 169:25, 170:12, 171:3, 171:8, 171:10, 177:2, 177:14, 178:24, 179:15 reason [5] - 84:11, 84:13, 92:22, 109:9, 168:21 reasonable [2] - 51:7, 109:6 reasons [9] - 18:15, 84:14, 87:6, 144:5, 152:25, 162:23, 163:7, 168:22 receive [1] - 34:16 received [10] - 34:18, 60:5, 60:7, 60:11, 102:10, 141:16, 156:4, 162:17, 163:2, 169:8 receiving [2] - 92:1, 140:22 recent [3] - 135:14, 137:7, 137:8 recently [1] - 125:17 Recess [4] - 55:12, 117:14, 131:3, 187:6 recess [1] - 131:2 recessed [1] - 200:12 record [20] - 47:8, 49:20, 79:7, 81:11, 81:21, 92:6, 97:3, 101:5, 134:17, 170:8, 170:21, 180:2, 187:14, 189:6, 189:24, 196:1, 196:4, 196:5, 196:15, 201:5 recorded [1] - 6:19 records [1] - 26:12 recourse [1] - 123:25 recover [1] - 30:17 RECROSS [1] - 146:8 red [8] - 7:25, 20:13, 168:17, 168:19, 169:6, 172:12, 174:2, 177:1 redirect [4] - 23:18, 54:23, 54:24, 199:8 REDIRECT [1] - 142:3 reduce [2] - 10:8, 18:15 reduced [1] - 143:10 reduces [1] - 176:18 reducing [2] - 10:11, 123:6 reduction [4] - 10:15,	10:19, 10:22, 121:13 Reed [2] - 6:4, 6:11 refer [2] - 57:19, 156:10 referenced [1] - 151:19 referred [4] - 11:1, 16:13, 174:18, 192:4 referring [11] - 83:23, 83:24, 89:5, 93:14, 94:19, 133:12, 133:17, 192:12, 192:16, 193:1, 194:16 refining [1] - 118:21 reflect [3] - 78:21, 96:23, 145:2 reflected [7] - 43:2, 47:1, 47:3, 47:25, 92:3, 164:11, 164:12 reflecting [4] - 43:20, 48:22, 49:23, 73:21 reflective [1] - 170:15 reflects [11] - 44:21, 46:17, 48:1, 48:24, 49:9, 49:14, 53:6, 80:19, 96:24, 98:24, 100:16 refresh [1] - 152:3 regard [2] - 69:16, 152:10 regarded [2] - 170:18, 178:10 regarding [2] - 11:4, 15:24 regards [1] - 45:7 region [1] - 197:8 regions [2] - 86:25, 87:12 regularly [1] - 26:12 regulate [1] - 123:19 regulation [1] - 129:4 regulations [2] - 14:12, 15:5 regulator [2] - 180:25, 181:6 regulators [2] - 155:24, 179:20 regulatory [6] - 19:2, 62:25, 63:4, 64:16, 128:23, 163:12 reimbursement [1] - 74:16 relate [2] - 64:5, 153:17 related [12] - 13:10, 14:12, 16:21, 61:19, 61:23, 62:12, 64:8, 64:12, 65:20, 72:13, 78:14, 135:7
Q	R			
qualifications [3] - 40:18, 151:15, 155:18 qualified [8] - 36:17, 62:15, 158:5, 160:8, 160:13, 160:16, 163:17, 181:24 qualitatively [3] - 80:1, 92:18, 102:22 quality [1] - 124:19 quantify [2] - 17:14, 42:17 quantitative [7] - 17:1, 17:3, 17:4, 17:6, 17:9, 18:17, 19:6 quantities [1] - 73:24 quantity [27] - 18:10, 38:14, 42:22, 43:6, 65:21, 66:4, 66:7, 66:18, 66:20, 67:3, 68:5, 69:10, 69:25, 70:19, 73:12, 73:19, 73:21, 73:25, 74:4, 77:5, 87:25, 88:15, 118:11, 118:16, 119:8, 121:13, 123:6 quarter [2] - 19:25, 184:2 Quarterly [1] - 59:5 questioning [1] - 191:7 questions [21] - 14:12, 23:19, 51:11, 51:21, 54:22, 107:25, 117:20, 117:23, 130:8, 131:11,	rackets [1] - 147:21 Rafalski [22] - 151:14, 152:2, 152:11, 152:18, 152:22, 154:3, 165:18, 165:22, 166:17, 166:20, 166:25, 167:2, 167:9, 170:9, 170:15, 170:19, 174:15, 174:18, 174:23, 187:22, 188:8, 188:22 Rafalski's [3] - 165:20, 166:23, 167:5 rafalski's [1] - 154:16 Rafferty [1] - 2:10 rain [3] - 71:12, 71:15, 71:17 raining [1] - 71:14 raise [3] - 24:16, 55:18, 150:17 raising [1] - 14:13 ran [3] - 180:5, 188:24 range [2] - 61:12, 133:18 rapidly [2] - 77:20, 82:22 rate [33] - 74:21, 74:22, 78:23, 80:9, 83:14, 88:9, 104:1, 105:4, 105:6, 105:9, 105:10, 105:14, 105:18, 105:21, 106:1, 107:20, 108:4, 108:9, 108:17, 109:16, 109:18, 109:19, 109:23, 110:12, 110:17, 110:21, 112:2, 114:1, 114:2, 114:4, 115:2, 117:4, 153:11 rates [13] - 80:3, 80:5, 80:25, 89:18, 89:19, 90:6, 90:7, 91:17,			

Ayme A. Cochran, RMR, CRR (304) 347-3128

<p>scales [1] - 83:6</p> <p>scatter [3] - 102:2, 138:5, 138:14</p> <p>schedule [1] - 148:11</p> <p>scheduled [1] - 199:18</p> <p>scheme [2] - 30:11, 30:18</p> <p>SCHMIDT [1] - 5:9</p> <p>scholarly [1] - 59:3</p> <p>School [3] - 56:6, 56:21, 145:10</p> <p>school [1] - 127:13</p> <p>Schultz [1] - 125:17</p> <p>science [3] - 35:13, 36:3</p> <p>Science [1] - 25:8</p> <p>Sciences [1] - 60:21</p> <p>scientific [3] - 134:17, 136:19, 179:19</p> <p>scope [19] - 13:7, 13:11, 14:11, 16:9, 16:22, 20:14, 20:17, 21:1, 21:19, 22:25, 23:14, 38:16, 40:11, 41:16, 81:21, 81:23, 92:6, 163:15, 196:16</p> <p>screen [4] - 166:17, 169:23, 173:9, 174:15</p> <p>se [3] - 35:9, 66:6, 98:16</p> <p>season [1] - 198:22</p> <p>seat [4] - 24:19, 55:22, 107:25, 150:21</p> <p>seats [1] - 192:21</p> <p>second [14] - 25:4, 42:10, 44:13, 76:4, 84:10, 85:23, 99:2, 134:24, 139:7, 143:6, 144:9, 153:5, 169:18, 169:19</p> <p>secondly [1] - 110:11</p> <p>seconds [1] - 130:7</p> <p>section [3] - 33:2, 33:4, 90:3</p> <p>sectional [2] - 72:6, 72:9</p> <p>sectionally [1] - 87:11</p> <p>see [83] - 12:4, 15:21, 15:23, 23:2, 23:5, 44:14, 45:5, 45:7, 50:17, 50:21, 54:12, 66:4, 67:10, 71:11, 72:19, 75:1, 76:19, 77:23, 82:7, 82:18, 83:25, 84:20, 85:7, 86:5, 87:10, 88:12, 88:17, 88:18, 88:23, 89:3, 90:3, 90:5,</p>	<p>90:8, 90:14, 90:24, 91:16, 91:18, 92:15, 92:17, 92:19, 92:21, 92:24, 95:9, 95:16, 97:12, 99:4, 99:8, 100:18, 100:25, 101:18, 102:6, 102:22, 103:7, 117:5, 123:14, 123:21, 124:16, 124:18, 124:20, 125:24, 127:2, 128:2, 131:15, 134:14, 137:21, 167:11, 168:18, 169:24, 171:8, 173:16, 174:20, 174:21, 179:16, 184:16, 191:17, 194:1, 194:10, 194:11, 196:7, 200:9</p> <p>seeing [4] - 7:22, 80:18, 93:16, 145:18</p> <p>seem [3] - 87:4, 102:3, 103:7</p> <p>sees [1] - 175:8</p> <p>segue [1] - 82:4</p> <p>sell [2] - 65:6, 67:6</p> <p>sellers [1] - 118:12</p> <p>selling [1] - 194:21</p> <p>sells [1] - 37:17</p> <p>Sen [1] - 35:24</p> <p>Sen's [1] - 35:25</p> <p>Senate [1] - 62:23</p> <p>SENIOR [1] - 1:17</p> <p>Senior [1] - 7:2</p> <p>senior [2] - 60:18, 61:7</p> <p>Sensabaugh [1] - 5:14</p> <p>sense [10] - 42:20, 56:23, 58:23, 69:19, 77:3, 79:20, 127:7, 136:19, 140:4, 199:5</p> <p>separate [6] - 19:17, 38:12, 66:2, 86:15, 169:8, 169:11</p> <p>separately [3] - 81:4, 99:3, 99:4</p> <p>separating [1] - 79:1</p> <p>September [1] - 168:23</p> <p>September's [1] - 168:24</p> <p>sequence [4] - 143:25, 144:3, 145:2</p> <p>sequentially [1] - 72:2</p> <p>series [1] - 72:4</p> <p>serious [2] - 7:21, 142:17</p> <p>seriously [2] - 125:19,</p>	<p>140:25</p> <p>Serp [3] - 44:1, 46:3, 48:19</p> <p>serve [4] - 29:6, 29:9, 61:7, 157:19</p> <p>served [6] - 8:19, 8:22, 29:12, 31:8, 62:1, 62:4</p> <p>service [1] - 33:14</p> <p>Service [2] - 34:19, 56:5</p> <p>services [1] - 32:24</p> <p>serving [2] - 32:11, 33:20</p> <p>set [3] - 169:6, 171:20, 174:6</p> <p>sets [1] - 154:9</p> <p>setting [1] - 104:7</p> <p>settings [1] - 155:23</p> <p>settled [1] - 31:5</p> <p>Settlement [1] - 30:21</p> <p>settlement [2] - 31:4, 31:6</p> <p>seven [2] - 73:16</p> <p>seventh [1] - 168:9</p> <p>several [3] - 109:17, 144:5, 145:12</p> <p>shaking [1] - 127:1</p> <p>SHANNON [1] - 6:3</p> <p>shape [2] - 79:7, 81:12</p> <p>shapes [1] - 83:8</p> <p>share [10] - 23:6, 37:7, 155:13, 155:15, 184:13, 184:25, 185:2, 185:12, 185:20, 186:18</p> <p>shift [3] - 102:23, 103:9, 110:5</p> <p>shifted [1] - 93:4</p> <p>ship [1] - 194:24</p> <p>shipment [28] - 75:18, 85:16, 87:1, 89:18, 90:7, 97:14, 98:16, 138:13, 151:21, 153:21, 153:22, 162:19, 163:4, 163:6, 164:13, 164:17, 168:9, 169:3, 169:4, 170:17, 172:9, 175:3, 175:4, 178:7, 188:25, 193:15, 193:17, 197:4</p> <p>shipments [99] - 38:7, 42:5, 42:17, 72:12, 73:12, 73:14, 73:24, 75:10, 76:5, 76:15, 76:20, 77:15, 77:18, 84:5, 84:11, 84:17, 85:8, 85:14, 85:19,</p>	<p>85:20, 86:16, 86:20, 87:2, 87:6, 87:15, 87:19, 87:21, 88:6, 89:12, 89:16, 90:2, 90:12, 96:25, 97:7, 98:2, 151:23, 154:7, 154:9, 154:20, 159:18, 161:9, 162:21, 162:24, 163:1, 163:8, 164:19, 165:11, 165:15, 167:25, 169:6, 169:16, 169:17, 170:1, 170:3, 172:5, 172:11, 172:12, 172:16, 172:20, 172:22, 173:20, 173:23, 174:5, 174:6, 175:15, 175:17, 176:8, 176:11, 176:12, 176:23, 178:8, 178:10, 178:13, 180:13, 180:20, 183:20, 183:23, 184:6, 184:7, 184:14, 186:3, 186:6, 186:20, 189:16, 190:6, 192:15, 192:18, 193:16, 193:17, 193:24, 194:17, 194:19, 195:15, 195:16, 197:12, 198:3, 198:7, 198:13, 199:4</p> <p>shipped [17] - 13:22, 17:15, 38:14, 41:3, 42:22, 43:6, 44:15, 48:7, 48:10, 48:14, 49:15, 50:9, 65:13, 73:25, 76:24, 168:2, 168:6</p> <p>ships [1] - 185:22</p> <p>short [1] - 24:1</p> <p>show [13] - 16:6, 80:4, 80:8, 80:15, 81:1, 82:12, 82:23, 86:7, 87:15, 91:1, 94:7, 97:4, 122:1</p> <p>showed [3] - 13:5, 110:25, 171:1</p> <p>showing [3] - 80:3, 95:5, 99:20</p> <p>shown [6] - 13:21, 13:24, 159:5, 169:22, 176:17, 183:19</p> <p>shows [13] - 19:23,</p>	<p>46:6, 46:7, 49:22, 73:6, 73:19, 82:24, 109:1, 115:6, 122:10, 168:14, 171:2, 172:4</p> <p>sic [1] - 117:3</p> <p>side [19] - 57:25, 58:11, 58:13, 58:14, 66:3, 66:21, 92:21, 92:22, 118:14, 118:20, 127:8, 171:24, 172:2, 173:14, 176:6, 176:17, 176:18, 183:19, 184:4</p> <p>sides [1] - 189:23</p> <p>sign [1] - 178:19</p> <p>significance [8] - 89:4, 91:25, 92:4, 100:4, 101:12, 108:25, 133:10, 144:20</p> <p>significant [8] - 28:19, 50:18, 69:12, 77:11, 89:2, 89:20, 122:10, 157:25</p> <p>significantly [4] - 37:17, 48:2, 81:14, 163:8</p> <p>signifies [1] - 88:4</p> <p>signify [1] - 72:1</p> <p>signing [2] - 26:22, 26:23</p> <p>similar [18] - 45:7, 48:24, 82:7, 82:24, 83:8, 86:9, 87:1, 92:19, 92:20, 92:21, 96:2, 97:17, 97:19, 98:2, 98:3, 175:13, 183:11, 199:17</p> <p>similarly [1] - 59:22</p> <p>simple [10] - 71:20, 75:1, 75:3, 75:22, 90:23, 93:11, 93:13, 93:15, 101:18, 104:25</p> <p>simplifying [1] - 122:15</p> <p>simply [9] - 81:20, 136:10, 142:10, 143:24, 145:18, 159:4, 159:25, 169:1, 199:3</p> <p>SINGER [1] - 4:8</p> <p>single [2] - 153:2, 173:18</p> <p>sit [1] - 182:25</p> <p>sitting [2] - 19:19, 30:3</p> <p>situation [1] - 144:10</p>
---	---	--	--	---

<p>situations [1] - 35:17</p> <p>six [25] - 73:16, 151:20, 152:6, 152:19, 152:22, 154:2, 154:16, 159:5, 159:6, 166:10, 166:19, 167:10, 168:4, 168:5, 168:16, 168:25, 174:18, 175:1, 187:20, 193:7, 193:9, 193:16, 193:24</p> <p>six-month [2] - 167:10, 174:18</p> <p>size [5] - 38:14, 42:22, 43:6, 53:16, 89:1</p> <p>skewed [2] - 95:16, 95:18</p> <p>skinning [1] - 148:13</p> <p>skyrockets [1] - 81:17</p> <p>Slide [1] - 138:2</p> <p>slide [8] - 92:5, 120:3, 139:11, 139:16, 187:15, 192:19, 192:24, 193:2</p> <p>slight [1] - 33:12</p> <p>slightly [1] - 97:24</p> <p>sloping [2] - 121:24, 122:5</p> <p>slower [1] - 76:6</p> <p>small [2] - 88:21, 194:21</p> <p>smaller [2] - 83:15, 114:18</p> <p>Smith [2] - 6:4, 6:11</p> <p>social [1] - 59:25</p> <p>society [1] - 125:3</p> <p>Society [3] - 60:21, 60:23, 60:24</p> <p>softball [1] - 57:8</p> <p>sold [11] - 38:12, 52:24, 58:18, 65:25, 68:6, 69:11, 70:1, 70:20, 196:23, 197:7, 198:14</p> <p>solely [4] - 48:14, 49:1, 174:2, 177:2</p> <p>solid [10] - 41:3, 43:11, 44:9, 44:24, 45:1, 46:21, 48:8, 48:14, 49:10, 49:15</p> <p>solids [3] - 49:1, 49:3, 49:24</p> <p>Solids [1] - 49:13</p> <p>someone [1] - 36:21</p> <p>something's [1] - 194:23</p> <p>sometimes [6] - 71:21, 79:12,</p>	<p>116:16, 129:8, 155:23, 156:9</p> <p>somewhat [3] - 47:5, 81:16, 200:4</p> <p>somewhere [2] - 119:18, 133:11</p> <p>SOMS [1] - 163:18</p> <p>sorry [19] - 9:7, 10:17, 11:10, 11:11, 11:13, 11:25, 18:4, 21:5, 21:7, 22:11, 47:9, 51:18, 60:24, 70:18, 135:1, 191:10, 192:20, 199:25</p> <p>sort [7] - 45:7, 71:20, 93:3, 96:2, 105:8, 167:24, 178:16</p> <p>sounds [2] - 8:24, 149:25</p> <p>source [3] - 180:15, 180:25, 182:12</p> <p>sources [2] - 179:22, 188:19</p> <p>South [1] - 2:11</p> <p>Southern [2] - 7:2, 56:10</p> <p>SOUTHERN [1] - 1:1</p> <p>spare [1] - 50:21</p> <p>sparing [1] - 78:20</p> <p>speaking [1] - 170:24</p> <p>speaks [1] - 189:23</p> <p>spear [1] - 67:19</p> <p>specialists [1] - 35:18</p> <p>specialized [1] - 27:4</p> <p>specialty [1] - 63:13</p> <p>specific [4] - 27:7, 38:21, 155:10, 192:15</p> <p>specifically [4] - 64:5, 82:2, 134:12, 152:10</p> <p>specified [1] - 195:10</p> <p>speculating [1] - 18:18</p> <p>spend [2] - 149:1, 161:23</p> <p>spending [1] - 148:17</p> <p>spike [1] - 80:18</p> <p>sports [1] - 57:14</p> <p>spread [3] - 101:3, 101:4, 138:15</p> <p>square [2] - 89:9, 131:14</p> <p>Square [2] - 6:5, 6:12</p> <p>squared [1] - 89:13</p> <p>St [3] - 30:15, 36:4, 40:6</p> <p>stack [1] - 67:10</p> <p>staff [7] - 25:15, 26:4, 26:5, 26:7, 26:11, 26:19, 34:4</p>	<p>staffed [1] - 35:9</p> <p>stand [7] - 7:8, 19:20, 21:22, 24:13, 55:15, 148:11, 187:8</p> <p>STAND [1] - 7:10</p> <p>standard [7] - 19:2, 19:10, 19:14, 19:18, 22:5, 122:4, 124:20</p> <p>standing [1] - 106:9</p> <p>standpoint [8] - 10:25, 19:12, 70:6, 75:14, 84:24, 106:9, 127:12, 146:15</p> <p>STANNER [1] - 5:10</p> <p>start [12] - 7:18, 25:4, 26:25, 30:22, 45:5, 46:15, 104:24, 106:13, 136:2, 136:18, 143:12, 200:5</p> <p>started [7] - 54:19, 55:9, 56:15, 56:17, 135:23, 135:25, 161:2</p> <p>starting [3] - 44:4, 81:17, 176:3</p> <p>starts [3] - 82:20, 82:21, 175:1</p> <p>State [8] - 14:8, 14:25, 15:22, 25:21, 29:23, 29:25, 54:5, 54:19</p> <p>state [15] - 24:14, 29:10, 32:13, 55:16, 62:25, 63:4, 87:20, 88:5, 88:6, 92:11, 92:12, 138:9, 150:14</p> <p>state/federal [1] - 29:18</p> <p>statement [2] - 32:23, 189:22</p> <p>statements [3] - 26:7, 26:22, 32:25</p> <p>Statements [1] - 32:20</p> <p>STATES [2] - 1:1, 1:17</p> <p>states [11] - 26:1, 85:13, 85:14, 86:3, 97:4, 97:6, 102:2, 102:5, 103:6, 111:2</p> <p>States [3] - 7:2, 53:23, 62:19</p> <p>statistical [6] - 17:7, 19:12, 71:5, 71:6, 89:4, 138:23</p> <p>statistically [2] - 19:16, 89:2</p> <p>statistics [2] - 138:20, 139:19</p> <p>STATUS [1] - 1:17</p> <p>Status [1] - 7:2</p> <p>stenography [1] - 6:19</p>	<p>step [3] - 18:10, 18:23, 104:10</p> <p>STEVEN [1] - 4:22</p> <p>Sticking [2] - 38:16, 42:10</p> <p>Stigler [2] - 56:5, 57:4</p> <p>still [7] - 50:17, 114:24, 119:25, 120:8, 120:9, 194:23</p> <p>stipulate [1] - 47:10</p> <p>stipulations [1] - 148:20</p> <p>stock [1] - 163:3</p> <p>stopping [1] - 44:13</p> <p>store [1] - 67:9</p> <p>stories [3] - 97:25, 98:2, 98:3</p> <p>story [21] - 77:3, 80:1, 80:23, 82:8, 83:5, 84:15, 85:5, 89:23, 89:25, 90:23, 93:3, 93:11, 93:13, 93:15, 94:11, 96:18, 98:16, 101:18, 102:4, 103:2, 103:4</p> <p>straight [1] - 109:5</p> <p>straightforward [1] - 106:25</p> <p>Street [17] - 2:7, 2:11, 3:5, 3:7, 3:10, 3:12, 4:6, 4:9, 4:19, 4:21, 4:24, 5:5, 5:12, 6:6, 6:13, 123:15, 124:5</p> <p>streets [1] - 122:21</p> <p>strip [1] - 50:2</p> <p>strong [3] - 71:13, 87:15, 134:18</p> <p>strongly [1] - 88:25</p> <p>structure [1] - 146:11</p> <p>structures [1] - 64:9</p> <p>studied [1] - 121:5</p> <p>studies [4] - 8:25, 134:22, 135:3, 179:19</p> <p>Studies [1] - 181:3</p> <p>study [6] - 57:12, 58:2, 58:16, 70:22, 119:4, 141:13</p> <p>studying [2] - 127:14, 152:23</p> <p>stuff [2] - 111:10, 113:13</p> <p>subject [2] - 63:16, 187:3</p> <p>submit [1] - 149:13</p> <p>submitted [4] - 62:18, 62:24, 63:3, 149:17</p> <p>subsequent [7] - 153:21, 169:4, 170:17, 171:5,</p>	<p>175:4, 178:7, 188:11</p> <p>subsequently [1] - 144:1</p> <p>subset [2] - 44:20, 49:7</p> <p>substance [3] - 15:2, 43:21, 65:8</p> <p>Substance [1] - 127:11</p> <p>substances [11] - 14:6, 14:22, 15:6, 16:1, 18:2, 64:13, 64:24, 121:17, 144:15, 145:6, 158:18</p> <p>Substances [1] - 128:21</p> <p>substantial [5] - 78:13, 96:4, 115:7, 116:23, 141:9</p> <p>substantially [2] - 21:25, 24:5</p> <p>substantive [1] - 30:19</p> <p>substitute [6] - 145:18, 145:22, 147:14, 147:16, 147:19, 147:23</p> <p>substitutes [9] - 143:21, 145:25, 146:2, 146:16, 146:20, 146:21, 146:22, 147:2, 147:13</p> <p>subtle [1] - 131:12</p> <p>suburbs [1] - 66:17</p> <p>sufficient [1] - 142:8</p> <p>suggest [2] - 134:17, 138:20</p> <p>suggesting [2] - 123:17, 144:13</p> <p>suggests [1] - 153:8</p> <p>Suite [9] - 2:4, 2:7, 2:10, 2:13, 3:15, 4:6, 4:9, 6:5, 6:12</p> <p>summaries [1] - 43:20</p> <p>summary [1] - 48:23</p> <p>summer [1] - 54:20</p> <p>supervision [1] - 36:8</p> <p>supplement [1] - 161:20</p> <p>supplemented [2] - 161:14, 185:8</p> <p>supplements [1] - 161:11</p> <p>supplied [2] - 98:10, 123:23</p> <p>supplier [1] - 66:3</p> <p>suppliers [4] - 118:13, 119:8, 119:12, 124:2</p>
---	--	--	--	---

supplies [1] - 127:6 supply [53] - 10:11, 10:15, 10:19, 58:11, 58:14, 63:25, 66:2, 66:5, 66:6, 66:12, 66:21, 68:10, 73:13, 73:18, 74:1, 77:4, 86:11, 98:9, 99:16, 99:17, 99:19, 99:24, 100:1, 100:3, 102:3, 113:3, 113:4, 117:24, 118:2, 118:10, 118:12, 118:20, 118:23, 118:25, 119:1, 119:7, 119:8, 119:12, 119:24, 120:5, 126:1, 126:15, 126:21, 126:25, 127:3, 127:8, 127:12, 129:1, 129:3, 129:5, 129:6, 129:10, 129:20 support [4] - 31:21, 34:9, 109:12, 177:13 supported [1] - 98:8 supposed [8] - 14:15, 178:17, 179:5, 179:6, 192:24, 193:13, 193:20, 193:22 supposedly [1] - 178:9 suppression [1] - 102:21 Suspicious [3] - 158:16, 198:16, 198:17 suspicious [32] - 129:12, 151:24, 154:21, 164:20, 164:25, 169:5, 170:18, 172:17, 174:10, 175:18, 177:10, 178:10, 180:14, 184:8, 189:15, 197:11, 197:12, 197:16, 197:18, 197:21, 197:23, 197:24, 197:25, 198:1, 198:10, 198:13, 198:15, 198:20, 198:24, 199:1, 199:2, 199:4 sustain [1] - 129:17 sustained [2] - 127:17, 127:19 SUZANNE [1] - 4:20	switch [2] - 12:23, 145:18 SWORN [3] - 24:18, 55:20, 150:19 system [10] - 14:6, 14:23, 15:15, 15:17, 64:23, 124:7, 125:14, 163:18, 183:9, 183:18 System [2] - 64:12, 158:17 systems [2] - 18:1, 18:5 T tar [4] - 98:10, 99:25, 100:5, 100:9 task [1] - 53:22 tasked [1] - 31:20 taught [2] - 57:4, 117:21 tax [1] - 122:18 taxed [1] - 122:19 taxes [1] - 119:23 teach [14] - 32:21, 32:22, 33:2, 56:18, 56:20, 56:21, 57:11, 57:12, 57:13, 57:14, 57:17, 60:2, 146:23 teacher [1] - 104:11 teaching [6] - 56:15, 56:17, 56:18, 57:15, 58:4, 58:19 team [8] - 31:20, 34:9, 34:13, 35:5, 35:7, 35:20, 36:6, 36:21 team's [1] - 35:8 teams [2] - 28:23, 28:25 tech [1] - 104:13 technology [2] - 35:12, 35:24 Ted [1] - 25:1 TEMITOPE [1] - 4:13 temporal [2] - 143:25, 144:2 temporary [1] - 25:22 ten [7] - 91:14, 95:7, 95:19, 95:23, 95:24, 107:8, 141:2 tend [5] - 71:13, 110:3, 121:10, 121:19, 122:4 tended [1] - 112:1 tendency [1] - 71:10 tender [4] - 36:10, 63:12, 158:4, 160:12 tends [2] - 126:7, 126:16	tennis [2] - 147:21 tens [2] - 43:16, 43:18 Tenth [1] - 5:12 terabytes [1] - 157:4 term [2] - 133:22, 198:20 terminology [2] - 119:7, 129:3 terms [30] - 18:11, 26:22, 29:3, 32:24, 34:1, 35:23, 45:5, 69:4, 70:9, 71:2, 74:15, 83:8, 83:22, 87:1, 87:21, 91:16, 93:20, 97:4, 97:20, 99:24, 112:5, 114:14, 129:13, 135:18, 138:22, 138:23, 143:20, 171:24, 177:16, 200:3 terrorism [1] - 34:10 Terrorism [1] - 34:12 test [1] - 180:6 testified [24] - 29:22, 30:2, 30:13, 30:18, 31:14, 38:17, 38:24, 51:22, 52:7, 62:8, 62:22, 109:15, 126:2, 151:13, 152:16, 157:22, 165:22, 166:6, 167:2, 185:1, 189:3, 190:21, 195:10, 197:20 testify [4] - 15:24, 130:18, 151:11, 159:19 testifying [8] - 8:7, 29:19, 30:6, 30:25, 31:6, 39:11, 39:12, 62:7 testimonies [1] - 62:9 testimony [52] - 9:11, 9:12, 13:8, 15:19, 16:11, 16:19, 18:22, 21:15, 21:22, 29:15, 29:16, 39:8, 39:14, 62:18, 62:24, 63:3, 65:14, 65:17, 70:5, 103:14, 112:19, 134:16, 135:10, 137:5, 139:16, 147:1, 147:4, 152:3, 161:3, 163:16, 165:3, 165:20, 166:1, 166:23, 167:5, 170:9, 179:4, 179:18, 188:21, 189:8, 189:18, 189:22, 190:22, 190:24, 191:3, 195:3, 195:5, 196:24, 197:1, 199:18, 199:23 tests [1] - 168:9 Texas [1] - 26:1 THE [147] - 1:1, 1:1, 1:4, 1:17, 7:5, 7:7, 7:8, 7:9, 7:11, 7:12, 7:13, 13:12, 13:17, 14:14, 21:2, 21:17, 23:16, 23:18, 23:20, 23:22, 23:24, 23:25, 24:3, 24:6, 24:8, 24:12, 24:14, 24:15, 24:16, 24:19, 34:23, 34:25, 36:13, 36:18, 36:23, 40:15, 40:20, 47:16, 47:19, 51:1, 51:3, 51:12, 54:23, 54:25, 55:2, 55:4, 55:7, 55:11, 55:13, 55:17, 55:23, 55:24, 57:6, 63:14, 63:19, 70:11, 70:15, 81:19, 104:10, 104:12, 104:16, 104:19, 106:14, 106:18, 115:24, 116:1, 116:8, 117:9, 117:12, 117:15, 121:5, 127:17, 127:19, 127:22, 129:16, 129:24, 130:2, 130:4, 130:9, 130:12, 130:21, 130:23, 131:1, 131:4, 131:5, 131:6, 134:22, 134:24, 135:1, 141:19, 141:24, 141:25, 145:13, 145:15, 146:6, 147:5, 147:6, 147:18, 147:20, 147:25, 148:3, 148:6, 148:7, 149:15, 149:20, 149:25, 150:3, 150:8, 150:13, 150:16, 150:22, 150:23, 151:1, 158:7, 158:9, 158:11, 160:4, 160:7, 160:15, 160:21, 163:24, 165:5, 165:9, 182:3, 182:10, 182:14, 182:24, 183:1, 187:2, 187:5, 187:8, 187:18, 189:10, 189:19, 189:25, 191:11, 191:14, 196:13, 196:19, 199:8, 199:10, 199:12, 199:14, 199:20, 199:25, 200:5, 200:9 themselves [2] - 162:11, 190:4 THEODORE [1] - 24:18 Theodore [3] - 24:10, 24:15, 36:11 Theoretical [1] - 17:3 theoretical [8] - 124:13, 135:21, 137:3, 140:4, 140:7, 140:9, 142:25, 194:9 theoretically [2] - 17:19, 124:11 theories [1] - 84:19 theory [6] - 60:1, 85:1, 85:2, 85:16, 124:15, 142:18 therapy [2] - 18:10, 18:23 thereafter [2] - 159:18, 194:24 therefore [4] - 65:7, 66:12, 110:14, 170:17 thereof [1] - 153:18 they've [3] - 80:7, 133:16, 177:17 thinking [2] - 112:23, 125:19 third [5] - 11:1, 30:20, 114:20, 153:9 third-party [1] - 11:1 Thomas [2] - 2:10, 30:10 thousands [4] - 43:16, 43:19, 157:4, 157:5 Three [1] - 6:5 three [15] - 6:12, 30:4, 30:5, 65:20, 85:12, 87:13, 100:21, 103:1, 123:16, 137:12, 137:13, 137:20, 152:24, 172:5 threshold [23] - 168:8, 168:10, 168:15, 168:21, 168:25, 174:19, 175:2, 175:6, 175:9, 175:11, 175:20, 175:25, 176:4, 176:9, 176:13, 176:16, 176:24,
---	---	---

<p>177:3, 177:9, 178:11, 178:12, 193:19 thresholds [2] - 167:10, 174:6 threw [1] - 40:24 throughout [1] - 60:1 tightened [1] - 10:13 timing [3] - 82:2, 82:8, 148:25 TIMOTHY [1] - 5:9 tip [1] - 15:3 title [1] - 61:3 Tobacco [2] - 30:20, 30:21 today [26] - 19:19, 37:3, 37:7, 38:17, 38:20, 51:7, 56:18, 74:13, 78:19, 83:22, 96:25, 100:23, 123:21, 127:11, 139:19, 146:24, 149:6, 150:5, 150:7, 151:11, 159:19, 197:20, 199:16, 199:18, 200:7 together [13] - 71:9, 72:1, 72:5, 78:25, 79:2, 80:13, 81:4, 91:12, 101:2, 102:3, 104:1, 147:21, 162:10 tomorrow [6] - 130:18, 149:2, 149:7, 149:8, 149:9, 200:3 tongue [1] - 15:3 tonight [1] - 148:24 took [3] - 42:22, 136:1, 195:14 tool [1] - 19:17 tools [11] - 10:8, 11:5, 12:9, 17:8, 17:20, 18:9, 18:14, 18:24, 19:1, 19:9, 19:14 top [4] - 49:6, 59:6, 112:8, 139:5 topic [1] - 125:24 total [5] - 8:21, 44:9, 49:4, 183:23, 195:15 totality [1] - 46:17 toward [2] - 95:17, 111:25 Tower [2] - 3:4, 4:23 town [4] - 130:22, 148:4, 194:21, 199:24 track [2] - 37:20, 132:25 tracking [3] - 37:19,</p>	<p>158:21 Trade [4] - 34:14, 63:9, 155:25, 157:2 traditionally [1] - 98:10 trailing [2] - 167:10, 174:18 training [4] - 34:11, 35:1, 35:2, 146:13 trajectory [1] - 137:15 transacted [1] - 50:19 transaction [2] - 44:10, 157:3 transactional [14] - 13:3, 13:21, 38:2, 38:4, 38:6, 39:13, 43:12, 49:3, 52:1, 52:4, 53:4, 54:17, 161:14, 185:9 transactions [15] - 42:25, 43:15, 43:16, 43:19, 44:11, 44:21, 46:12, 46:13, 48:3, 49:5, 49:24, 50:20, 54:14, 124:1, 159:17 transcript [3] - 6:19, 188:10, 201:4 transformed [1] - 141:3 transgressed [1] - 16:7 transiting [1] - 93:15 transition [5] - 96:8, 101:19, 103:3, 134:7, 136:4 transitioning [2] - 29:3, 134:5 translated [1] - 132:1 treated [1] - 42:1 tremendously [1] - 122:23 trend [1] - 45:7 trending [1] - 44:14 trends [1] - 45:5 trial [13] - 29:15, 39:8, 62:7, 62:8, 62:10, 149:21, 152:17, 157:22, 161:2, 165:20, 166:1, 166:23, 188:10 TRIAL [1] - 1:16 Trial [1] - 200:12 trials [1] - 30:19 Tribunal [1] - 29:24 tribunal [2] - 30:3 tried [2] - 84:24, 191:16 tries [3] - 109:19, 129:5, 129:6 trigger [1] - 193:13</p>	<p>triggered [1] - 174:19 trip [1] - 148:4 tripled [2] - 109:24, 113:1 true [14] - 8:22, 10:14, 11:7, 69:19, 82:5, 119:16, 124:9, 128:1, 136:12, 137:4, 137:7, 137:14, 137:20, 153:24 trustee [2] - 30:14, 30:17 truth [1] - 159:5 try [9] - 76:10, 84:8, 120:4, 125:25, 128:19, 164:20, 191:24, 193:4, 198:21 trying [15] - 107:5, 108:8, 108:10, 108:24, 110:14, 117:5, 118:6, 123:22, 125:23, 127:10, 130:21, 136:10, 165:14, 192:10, 195:6 turn [14] - 65:12, 90:13, 133:9, 146:23, 162:24, 163:1, 165:17, 173:1, 173:2, 173:17, 173:18, 177:17, 181:2, 184:24 turned [7] - 168:17, 172:18, 173:6, 176:13, 177:9, 178:2, 181:5 turning [2] - 133:24, 163:6 turns [3] - 96:18, 98:7, 169:6 Twelfth [3] - 4:19, 4:21, 5:5 two [32] - 8:22, 30:18, 48:5, 48:8, 48:13, 48:25, 57:22, 72:1, 72:25, 75:5, 75:14, 76:3, 76:10, 83:3, 84:14, 86:3, 89:11, 89:14, 98:9, 99:10, 99:25, 112:4, 119:18, 145:15, 145:20, 145:22, 147:20, 148:18, 173:22, 178:17, 193:1, 199:17 type [10] - 10:3, 28:16, 94:8, 129:7, 156:12,</p>	<p>156:21, 156:23, 157:6, 171:2, 180:3 typed [1] - 117:24 types [8] - 42:11, 72:3, 74:25, 99:24, 145:17, 156:15, 179:17, 179:24 typically [6] - 27:5, 27:6, 35:9, 35:11, 122:2, 133:21</p>	<p>units [14] - 42:18, 42:21, 43:1, 43:7, 44:10, 49:4, 53:10, 53:12, 65:25, 107:8, 107:9, 168:1, 168:6, 193:11 universe [1] - 18:19 university [4] - 56:17, 56:19, 56:20, 125:16 University [18] - 25:8, 25:9, 32:18, 36:4, 56:7, 56:9, 56:10, 56:11, 56:14, 56:15, 56:24, 57:7, 57:11, 60:15, 106:10, 127:14, 156:4, 156:6 unlawful [10] - 151:24, 154:7, 154:21, 169:5, 170:18, 175:17, 178:11, 180:14, 184:8, 199:5 unless [2] - 126:3, 126:10 unpack [1] - 153:15 unrelated [1] - 154:17 unreliable [9] - 152:24, 153:8, 153:14, 154:1, 154:5, 154:14, 155:4, 167:1, 167:4 untreated [2] - 10:16, 10:20 unusual [2] - 121:14, 121:19 unweighted [1] - 88:19 up [105] - 9:18, 10:13, 21:9, 28:17, 30:23, 34:2, 34:6, 35:13, 44:1, 45:22, 46:3, 48:19, 52:20, 53:8, 66:19, 66:20, 69:6, 71:10, 71:17, 72:19, 72:22, 73:8, 75:4, 75:5, 75:6, 75:24, 75:25, 76:4, 76:6, 76:14, 76:22, 77:2, 77:19, 77:20, 78:16, 79:9, 79:23, 80:6, 80:25, 81:14, 82:19, 82:21, 83:1, 86:3, 88:2, 89:6, 91:1, 96:22, 96:25, 97:2, 97:24, 97:25, 99:6, 99:20, 100:13, 101:2, 101:8, 101:9, 101:11, 102:11, 107:15, 107:22, 108:19, 112:3, 113:16, 114:11,</p>
---	--	--	---	---

<p>114:14, 117:25, 118:1, 123:3, 123:5, 124:11, 124:24, 129:1, 130:12, 131:7, 133:1, 133:3, 133:16, 136:25, 139:13, 142:11, 142:23, 143:3, 143:23, 146:21, 149:5, 152:1, 152:2, 164:16, 166:16, 167:15, 167:24, 171:16, 174:14, 175:22, 177:22, 181:11, 185:15, 186:15, 187:15, 195:16 updated [2] - 149:19, 149:20 users [3] - 58:12, 135:11, 142:7 uses [9] - 109:24, 143:25, 161:17, 161:19, 168:8, 175:5, 175:9, 175:13, 199:2 usual [1] - 94:10 utilized [3] - 41:23, 169:9, 183:15</p>	<p>versus [4] - 21:21, 49:24, 100:5, 111:2 vertical [3] - 73:2, 88:14, 138:10 vice [1] - 107:10 view [12] - 64:16, 65:23, 65:24, 74:3, 96:11, 102:16, 108:4, 108:18, 111:21, 116:7, 142:8 viewed [2] - 102:19, 169:5 viewpoint [1] - 118:7 views [1] - 167:3 violence [2] - 122:20, 124:21 VIRGINIA [2] - 1:1, 1:18 Virginia [50] - 4:24, 7:3, 7:20, 9:17, 9:18, 10:5, 19:25, 26:1, 53:13, 53:21, 54:5, 54:20, 73:6, 82:5, 82:8, 82:17, 83:9, 83:10, 83:17, 83:19, 92:16, 102:17, 102:19, 102:20, 102:24, 110:13, 114:4, 114:5, 132:13, 132:24, 139:2, 139:7, 141:11, 141:22, 151:22, 172:7, 184:7, 185:24, 192:6, 192:9, 194:13, 196:10, 196:12, 196:22, 197:9, 198:4, 198:8, 198:10, 198:14 visual [4] - 172:2, 173:15, 176:6, 183:20 voir [2] - 158:8, 158:10 volume [15] - 54:1, 69:4, 132:7, 132:8, 132:10, 132:12, 132:23, 137:22, 168:9, 168:14, 168:24, 172:9, 175:15, 193:15, 197:7 VOLUME [1] - 1:16 volumes [1] - 197:4 voluminous [1] - 43:13 voodoo [1] - 57:25 vs [3] - 31:13, 187:25, 201:6</p>	<p>W</p> <p>wages [1] - 62:23 waited [1] - 135:2 WAKEFIELD [1] - 5:13 walk [2] - 117:23, 182:1 Wall [2] - 123:15, 124:5 war [2] - 106:13, 123:9 warned [1] - 22:23 Washington [7] - 4:7, 4:10, 4:19, 4:21, 5:5, 5:12, 36:3 water [2] - 142:13, 142:14 Waterhouse [1] - 28:3 ways [1] - 144:5 weak [3] - 88:18, 138:16, 138:21 WEBB [1] - 3:11 Webb [1] - 3:12 website [2] - 182:22, 195:11 week [3] - 148:10, 148:15, 149:13 weeks [1] - 193:9 weight [5] - 131:22, 131:24, 131:25, 132:2, 182:3 weighted [1] - 113:10 weighting [2] - 92:25, 93:1 weights [2] - 113:14 welcome [1] - 149:15 welcomed [1] - 149:10 West [49] - 7:3, 7:19, 9:16, 9:18, 10:5, 19:25, 26:1, 53:13, 53:21, 54:5, 54:19, 73:5, 82:5, 82:8, 82:17, 83:9, 83:10, 83:17, 83:18, 92:15, 102:17, 102:18, 102:20, 102:24, 110:13, 114:4, 114:5, 132:13, 132:24, 139:1, 139:6, 141:10, 141:22, 151:22, 172:7, 184:7, 185:24, 192:6, 192:8, 194:13, 196:10, 196:12, 196:22, 197:8, 198:4, 198:8, 198:10, 198:14 WEST [2] - 1:1, 1:18 west [24] - 97:5, 97:6, 97:14, 97:16, 97:23,</p>	<p>98:1, 98:6, 98:20, 99:4, 99:6, 99:7, 99:9, 99:20, 100:1, 100:18, 100:19, 100:24, 101:6, 101:8, 103:7, 110:21, 111:2, 113:20, 113:25 western [2] - 96:21, 98:10 whereas [3] - 91:13, 95:17, 175:3 whisper [1] - 130:8 whole [10] - 57:24, 81:25, 82:1, 82:3, 82:14, 83:15, 94:15, 133:7, 134:6, 146:23 wholesale [1] - 128:17 WICHT [1] - 4:18 wide [4] - 14:15, 58:22, 61:12, 189:11 widely [4] - 59:9, 59:11, 59:18, 123:1 Williams [2] - 4:18, 5:4 willing [4] - 115:16, 119:8, 119:12, 119:15 willingness [2] - 118:12, 118:13 winners [2] - 30:17, 57:2 wise [1] - 87:11 witness [36] - 8:7, 8:16, 8:20, 13:15, 24:11, 40:18, 43:25, 50:21, 54:25, 55:6, 55:15, 62:1, 62:5, 117:8, 148:9, 149:6, 149:8, 150:6, 150:9, 150:12, 158:8, 158:10, 160:8, 160:13, 160:16, 163:17, 163:19, 165:2, 182:13, 187:8, 189:4, 189:8, 191:7, 199:17, 200:2 WITNESS [33] - 7:7, 7:9, 7:10, 7:12, 23:24, 24:3, 24:15, 24:18, 34:25, 55:4, 55:17, 55:20, 55:24, 70:15, 104:12, 104:16, 104:19, 121:5, 130:23, 131:5, 134:22, 135:1, 141:24, 145:15, 147:5, 147:20, 148:6, 150:16, 150:19,</p>	<p>150:23, 165:9, 187:5, 199:14 witness's [1] - 13:8 witnesses [4] - 148:19, 149:5, 199:16, 199:17 WOELFEL [1] - 3:9 Woelfel [2] - 3:9 women [5] - 91:6, 91:10, 91:12, 91:13, 91:22 wonder [1] - 13:14 WONDER [1] - 102:21 word [6] - 131:21, 132:7, 150:3, 197:18, 198:1, 199:2 words [3] - 49:2, 85:7, 89:17 work's [1] - 122:7 works [8] - 59:10, 64:18, 67:11, 100:12, 106:22, 124:17, 126:13, 193:14 world [15] - 86:12, 87:18, 125:4, 125:21, 137:16, 137:17, 137:24, 137:25, 154:17, 179:7, 179:10, 179:24, 180:4, 180:9, 182:19 World [1] - 34:14 worry [1] - 116:24 worth [1] - 136:9 worthy [1] - 35:11 write [3] - 67:22, 105:14, 166:12 writing [2] - 22:6, 160:10 writings [1] - 125:5 written [11] - 7:19, 22:5, 22:9, 22:13, 22:15, 59:8, 76:25, 77:12, 105:16, 120:15, 123:15 wrote [2] - 139:14, 162:3 WU [50] - 5:10, 150:11, 150:25, 151:2, 151:4, 152:1, 152:5, 155:6, 155:8, 158:4, 160:12, 160:19, 160:22, 160:23, 163:19, 164:1, 164:2, 165:2, 165:8, 165:16, 166:16, 166:18, 167:14, 167:17, 170:5, 170:7, 171:16,</p>
<p>V</p> <p>VA [5] - 185:23, 186:4, 186:8, 186:11, 186:19 valid [5] - 153:24, 171:3, 174:10, 177:9, 183:3 validated [2] - 179:22, 189:14 validity [3] - 152:14, 171:6, 180:7 valuation [1] - 29:25 valuations [1] - 30:2 value [2] - 59:17, 60:3 valued [1] - 30:7 variable [1] - 73:4 variation [5] - 89:11, 89:17, 89:18, 98:23 variations [3] - 89:15, 90:11, 101:13 various [8] - 26:21, 35:15, 38:11, 58:16, 148:20, 155:22, 163:7, 183:25 vast [1] - 169:15 Ventura [1] - 3:15 verified [1] - 179:21 versa [1] - 107:10 version [1] - 90:23</p>				

171:18, 174:14,
 174:16, 177:22,
 177:24, 179:1,
 179:3, 181:11,
 181:13, 181:23,
 182:11, 182:16,
 182:17, 183:5,
 184:21, 184:23,
 185:15, 185:17,
 186:25, 189:7,
 191:5, 196:15, 199:9
Wu ^[4] - 150:10,
 160:10, 196:14,
 199:8
WV ^[6] - 2:8, 3:10,
 3:13, 4:24, 5:15, 6:9

Y

year ^[20] - 28:13,
 44:10, 45:21, 46:25,
 47:8, 49:4, 60:8,
 73:3, 84:15, 88:7,
 97:8, 131:20,
 132:13, 180:18,
 182:22, 183:9,
 183:12, 195:23
years ^[34] - 8:8, 8:9,
 11:10, 11:12, 29:6,
 30:24, 31:3, 32:3,
 33:7, 33:10, 33:19,
 45:6, 46:14, 48:3,
 61:6, 73:1, 73:16,
 91:7, 95:7, 95:19,
 95:23, 95:25, 125:9,
 125:10, 135:14,
 137:7, 137:8, 141:2,
 156:8, 157:5, 186:11
yellow ^[5] - 44:18,
 44:20, 44:21, 45:23
yesterday ^[6] - 10:7,
 17:11, 18:9, 20:2,
 20:6, 24:1
York ^[3] - 3:5, 25:21,
 27:1
Young ^[2] - 31:12,
 31:13
young ^[4] - 91:10,
 91:12, 91:19
younger ^[7] - 91:15,
 91:20, 93:1, 93:7,
 95:17, 102:24
yourself ^[7] - 24:24,
 27:17, 27:19, 27:22,
 56:3, 151:5, 180:8

Z

zip ^[1] - 197:13
Zoom ^[1] - 199:24